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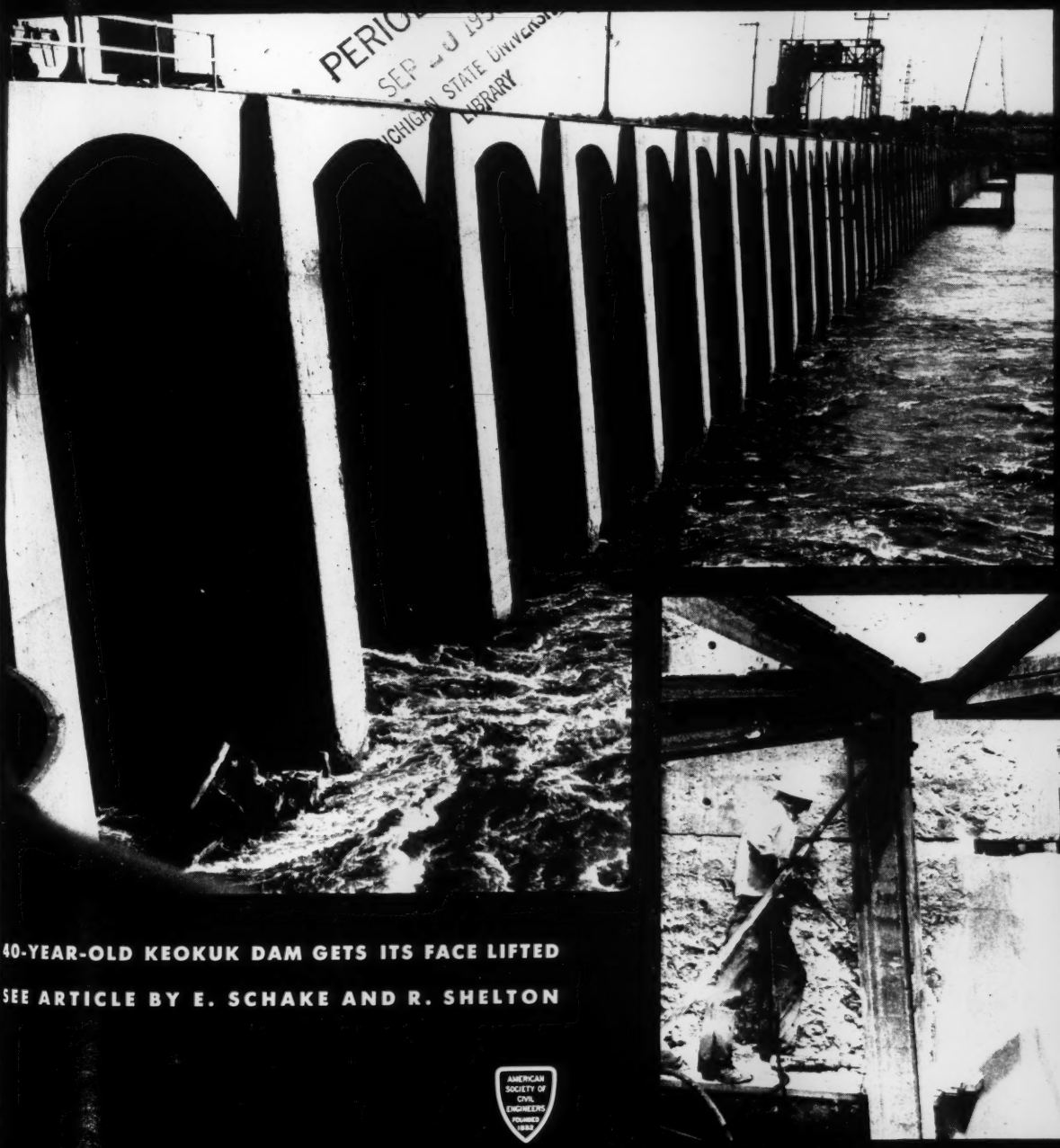

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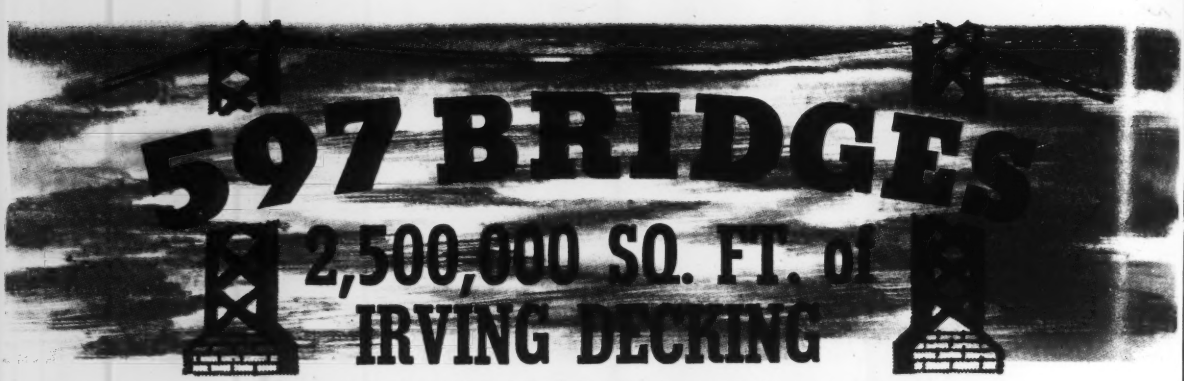

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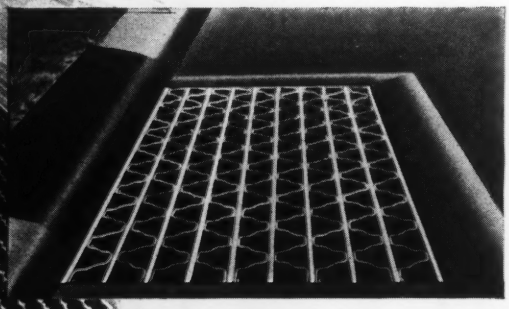

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CIVIL ENGINEERING

SEPTEMBER 1955
VOL. 25 • NO. 9

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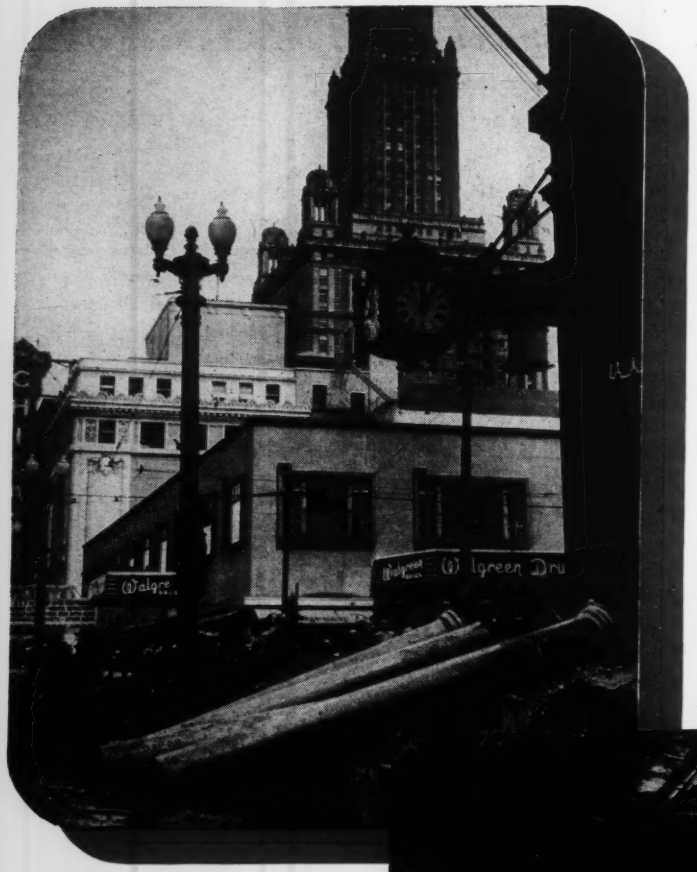
When the job calls for a



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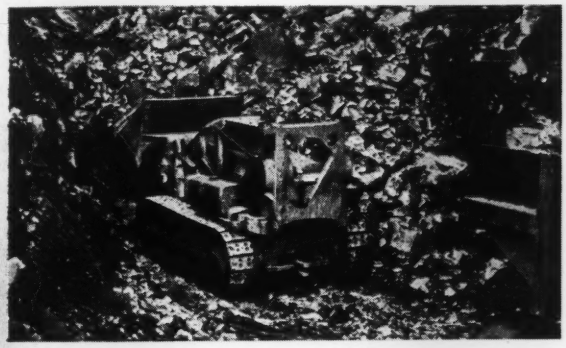

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In any rock excavation — mine, tunnel or open-cut — time and experience proves that the Eimco 105 Tractor-Excavator is the most efficient, in terms of speed, capacity and over-all costs.

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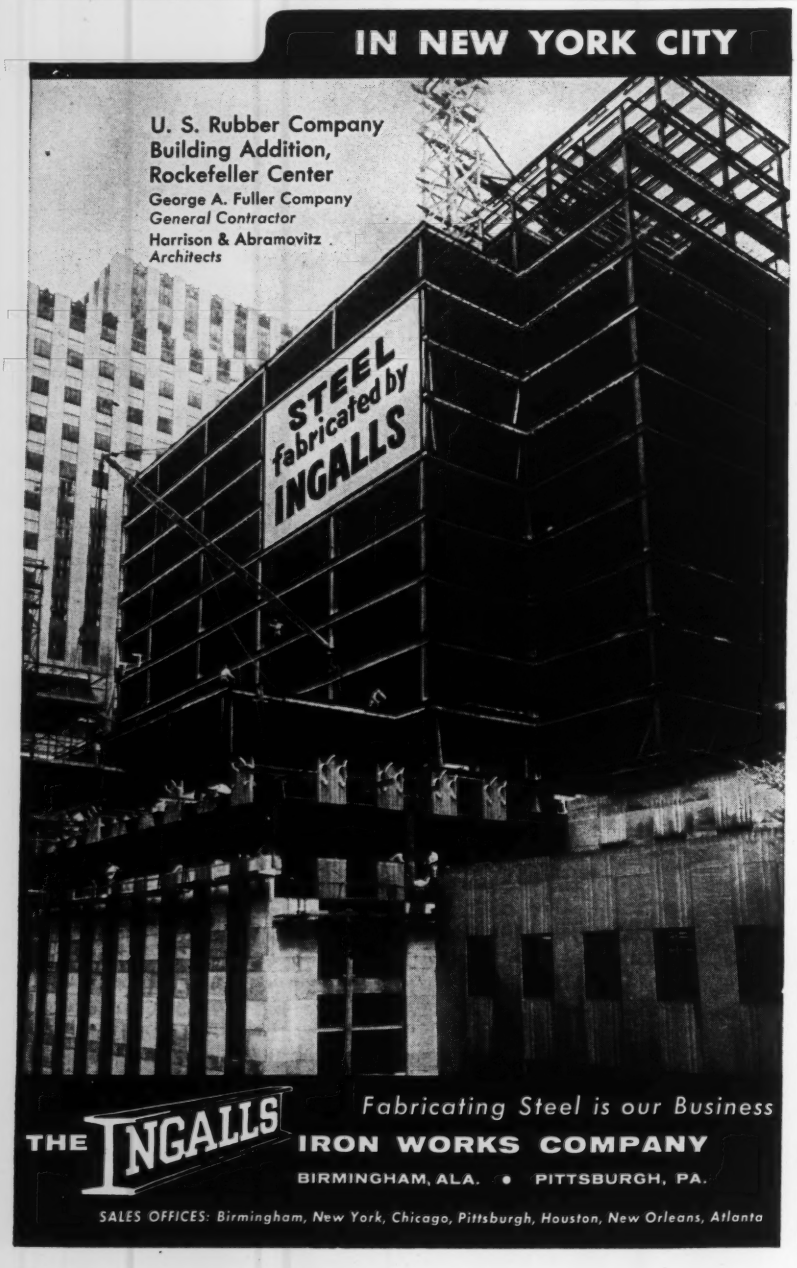
NEWS OF ENGINEERS

Harmer A. Weeden becomes associate professor of civil engineering at the University of Pennsylvania September 1. For the past five years Mr. Weeden has been associate professor at Bucknell University.

John F. Bonner has been promoted from assistant engineer to assistant chief engineer and assistant to the vice-president of the Pacific Gas and Electric Co., San Francisco. Mr. Bonner has been with the company since 1937.

Harry S. Lewis, who has been on assignment during the past year on Arctic Air Base planning as civil structural engineer with W. C. Hedrick in Richmond, Va., and with Metcalf & Eddy, Hopkins in Boston Mass., is now with W. C. Hedrick in Iceland on construction supervision of the above program.

Robert L. Peurifoy, professor of civil engineering at A. & M. College of Texas, College Station, Tex., was elected chairman for one year of the Civil Engineering Division of the American Society for Engineering Education at the annual meeting held in July. Other ASCE members holding office in the Division are: **John W. Hubler,** consulting engineer with Macomber Inc., Canton, Ohio, past-chairman; **Arthur J. McNair,** professor of civil engineering at Cornell University, representative to council; **Benjamin A. Whisler,** head of the civil engineering department at Pennsylvania State University, director and secretary; **Russell C. Brinker,** professor and head of the civil engineering department at Virginia Polytechnic Institute, director; and **Robert B. B. Moorman,** professor and chairman of the department of civil engineering at Syracuse University, director.



William E. Dickinson has been promoted from highway and concrete engineer to chief engineer for the Calcium Chloride Institute, Washington, D.C. Mr. Dickinson's professional experience includes service with the Corps of Engineers, active duty with the Navy in World War II, and consulting engineering work.

Thomas A. Bedford, Jr., for the past twenty-three years an executive with various affiliated companies of Henry J. Kaiser Co., has joined Kaiser Engineers Division as vice-president. Mr. Bedford has returned to the Oakland, Calif., headquarters of the organization, after ten years with Kaiser Motors Corporation and Willys Motors Inc., in which firms he is a director and vice-president. Until recently his headquarters were at Willow Run, Mich.

Erwin E. Shalowitz, construction management engineer with the Bureau of Yards & Docks, has become public information officer for the Civil Engineer Corps Reserve Unit of Washington, D.C. New assistant program officers are: **Norman H. Moore,** engineer with the Washington office of the Bureau of Reclamation, and **William R. Herron,** management engineer, Office, Chief of Engineers.

Edward R. Stapley, since 1942 Dean of engineering at Oklahoma A. & M. College, Stillwater, Okla., is retiring September 1. Dean Stapley will become dean emeritus of A. & M.'s Oklahoma Institute of Technology and professor emeritus of civil engineering. A 1914 graduate of Cornell, Dean Stapley holds a master's degree in civil engineering from Cornell and a master of science degree in sanitary engineering from Harvard. He has been at Oklahoma A. & M. since 1925.

Ralph J. Nopper, with Libbey-Owens-Ford Glass Company, Toledo, Ohio, since 1940, and recently in charge of maintenance engineering for company plants, has been named chief maintenance engineer. Mr. Nopper was with the E. B. Badger & Sons Co., and Howard C. Baker Co., before joining Libbey-Owens-Ford.

George S. Robinson, Captain, Navy Civil Engineer Corps, was awarded the Croix de Chevalier of the Legion of Honor in a ceremony at the French Officers Club in Paris this July. Captain Robinson was cited for his outstanding services in furthering NATO and the U.S. military construction programs in France. He has been serving as chief of the Operations Division, Joint Construction Agency since 1953 and recently was reassigned to Washington, D.C., to be technical adviser in the Shore Establishment Division, Bureau of Aeronautics.

G. S. Robinson

Ritchie Lawrie, Jr., since 1921 co-partner of Lawrie and Green, consulting firm of Harrisburg, Pa., has been elected to the board of trustees of Washington College Academy, Washington College, Tenn.

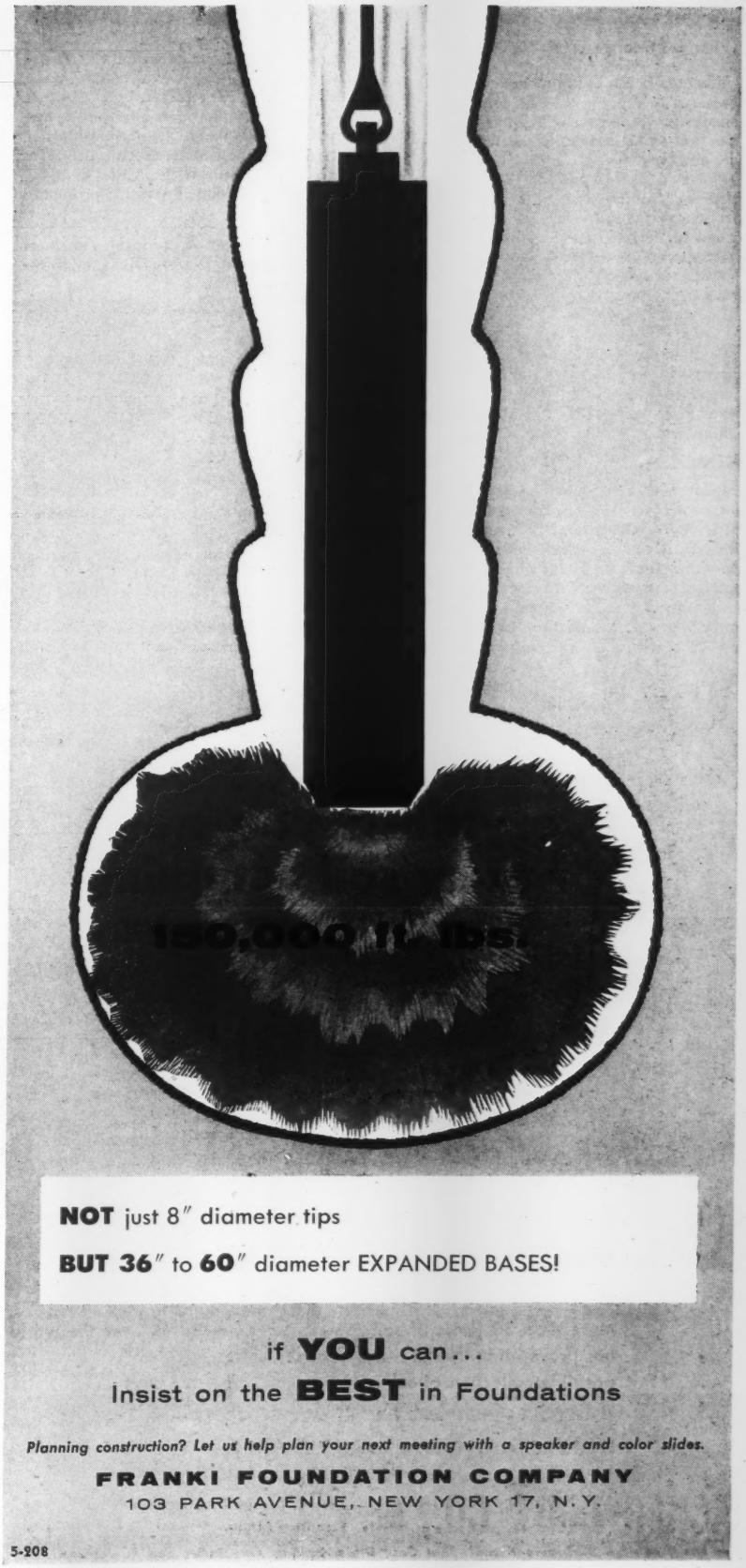
Eugene P. Light, president of Cunningham Engineers, Inc., has been elected a vice-president of Cunningham - Limp Co., general contractors of Detroit, Mich. Mr. Light joined the company this January after nineteen years in various capacities with the Austin Company. He was previously engineer for the Ohio State Highway Department.

© *Lens—Art Photo*

E. P. Light

Francis S. Friel, consulting engineer of Philadelphia, Pa., announces the removal of the office of Albright & Friel to Suite 1500, 3 Penn Center Plaza, Philadelphia, Pa. The firm specializes in municipal engineering, water supply and purification, sewage collection and disposal, and industrial waste and refuse disposal.

(*Continued on page 24*)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News of Engineers

(*Continued from page 23*)

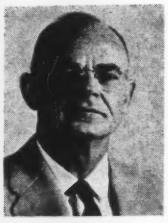
Vincent J. P. LeBlanc has joined the Massena, N.Y., office of Uhl, Hall & Rich, consulting engineers of Boston, for construction work on the St. Lawrence seaway and power project. Mr. LeBlanc was engineer assistant for the Maine State Highway Commission at Lewiston until last winter when he left to work on the design of the Housatonic River Bridge in Connecticut for the New York City firm, Parsons, Brinckerhoff, Hall and MacDonald.

George R. Halton, senior consulting engineer of George R. Halton, Engineering Consultants, Newark, N.J., has established a second resident consulting office at Columbus, N.J.

George H. Lacy and **Lowber D. Snow,** both with the Gulf Oil Corp., Gulf Coast District at Houston, Tex., retired recently. Mr. Lacey had been with Gulf Oil since 1917, and was chief civil engineer at the time of his retirement. A company employee since 1919, Mr. Snow was special assistant to the general manager.

Theron D. Weaver, Brigadier General, U.S. Army, has been recalled to active duty and named president of the Beach Erosion Board, Army Corps of Engineers, Washington, D.C. General Weaver retired in 1952 while chief engineer of the U.S. Army in Europe. For the past two years he has served as a consultant to Lt. Gen. S. D. Sturgis, Jr., Chief of Army Engineers, on special civil works problems.

Penn P. Livingston, hydraulic engineer with the Ground Water Division of the U.S. Geological Survey, retired recently after more than thirty-two years of service. He is now with the Ralph M. Parsons Co., Los Angeles, as senior hydrologist on an exploratory test-drilling program for irrigation water in India, which the company is conducting for the Indian government. Mr. Livingston's office is in New Delhi.



P. P. Livingston

Elmo L. Di Biagio, of Houtzdale, Pa., has received a Fulbright Grant to study civil engineering at the Norwegian Institute of Technology at Trondhjen, Norway. Mr. Di Biagio has held a two-year graduate assistantship at Princeton University doing research in soil mechanics, foundations, and structures for the Navy Bureau of Yards and Docks.

Bernhard Dornblatt, senior partner of B. M. Dornblatt & Associates, Inc., New Orleans, La., was appointed to membership on the New Orleans City Planning Commission in June.

Francisco Correia de Araújo has been appointed professor of structural engineering and bridge engineering in the college of engineering at the University of Porto, Porto, Portugal. He was previously associate professor of structural engineering there.

William A. Cawley, of Malden, Mass., has joined the engineering department of Rayonier, Inc., New York City. For several years Mr. Cawley worked for the Massachusetts Department of Public Health. His new work will be on sanitary engineering problems, investigations and studies of disposal and waste treatment.

(*Continued on page 28*)

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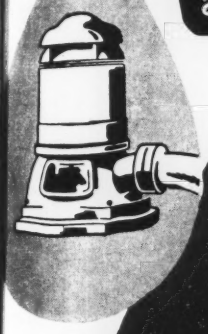

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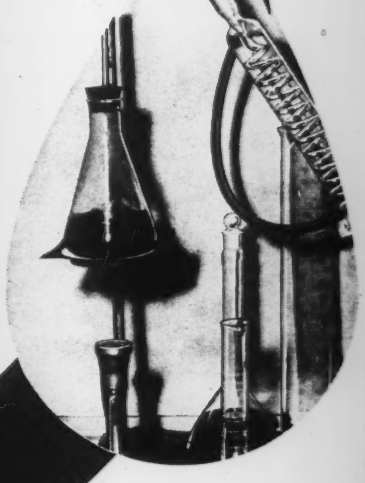

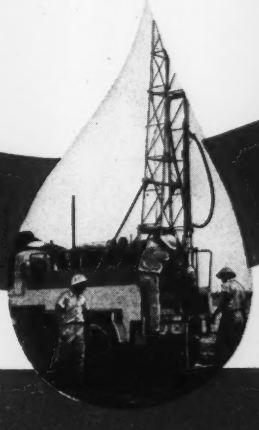

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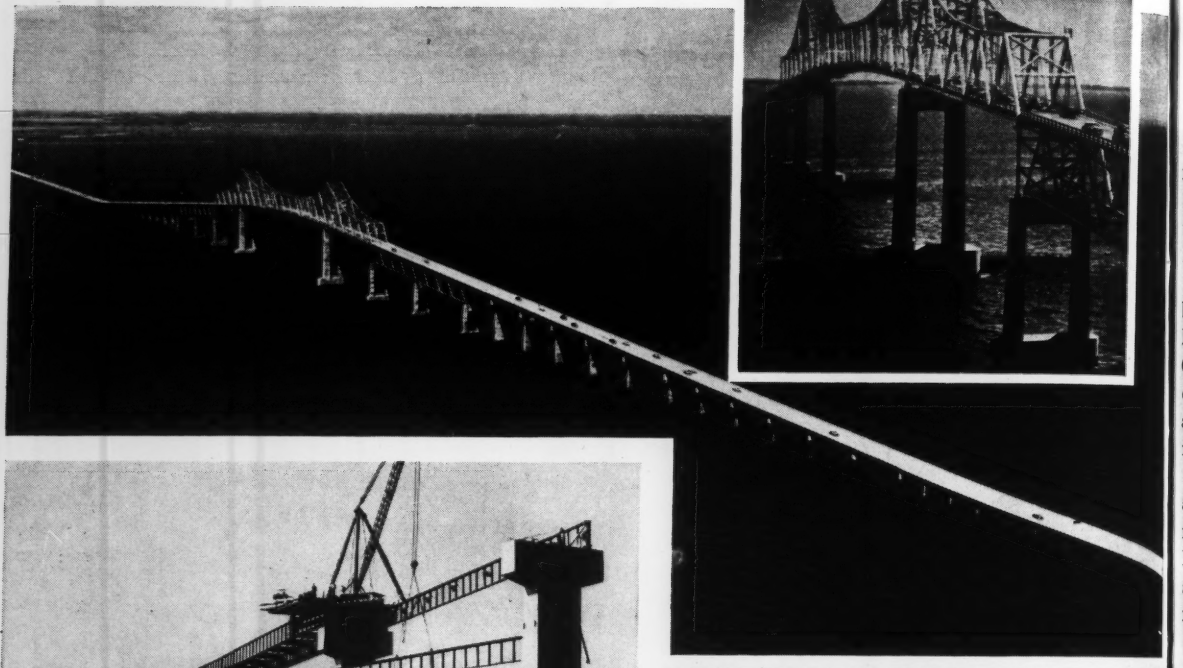
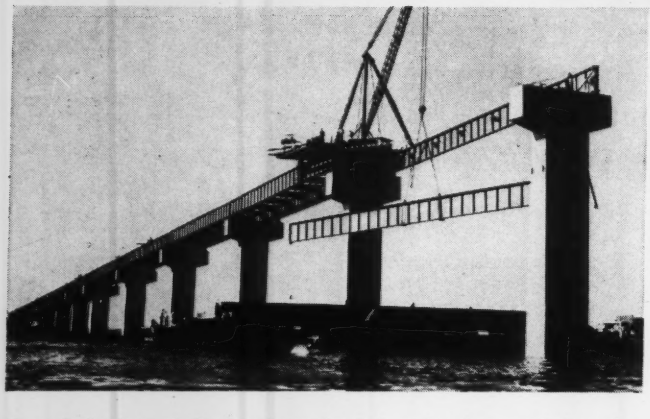
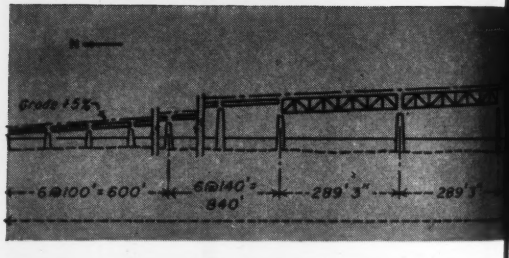
Miles from land, far out on Florida's spectacular Sunshine Skyway

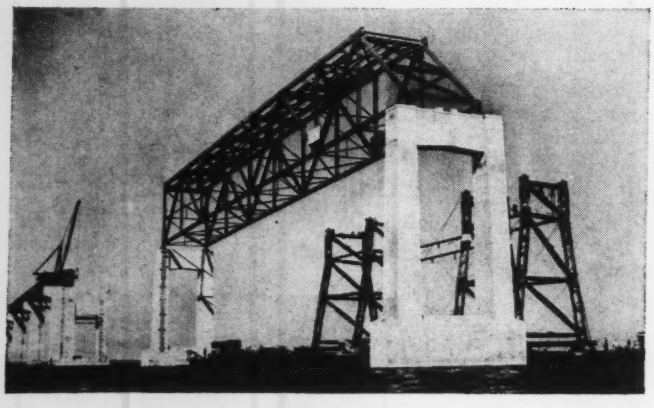
5,621-Ft. Superstructure for Mullet Key Channel



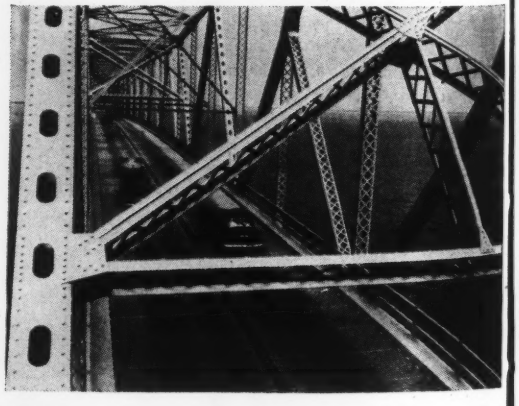


One deck plate girder has been landed on its shoes and the other is being made ready for landing.





Span in position as barges with falsework move away from site.



Looking down on I-Beam-Lok open-type steel flooring of the 864' main span over ship channel.

Bridge is a Remarkable Engineering Achievement

Working entirely over water, AMERICAN BRIDGE erects long, high section in 15 months!

Biggest single project on Florida's monumental $21,000,000 Sunshine Skyway across Lower Tampa Bay is the 22,300-foot Mullet Key Channel Bridge shown at the left.

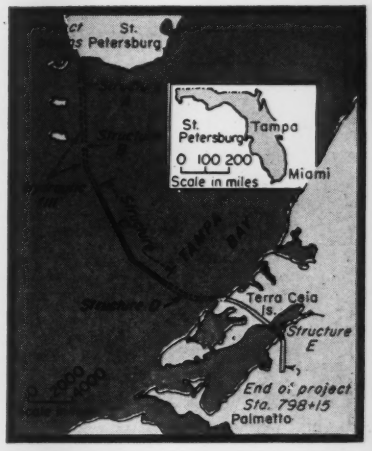
Both ends of structure "C" of this bridge are miles from the nearest land. Erection of the 5,621-foot, 6,300-ton steel superstructure was done entirely over water with girder and truss approach spans being floated to the site on special barges.

There are 31 steel spans totaling 5,621 feet in length in the section fabricated and erected by American Bridge. The through cantilever truss structure is 1,584′ long with a 864′ main cantilever span. Vertical clearance under the main span is 150′6″ above mean low water.

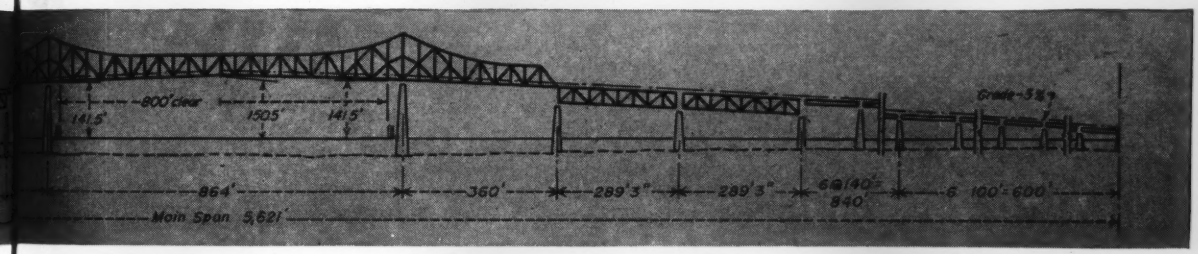
The bridge carries one 28′ roadway and two 2′ sidewalks. The main span of the cantilever structure has open-type USS I-Beam-Lok lightweight steel flooring.

Erection of this long, high structure began in May 1953 and was completed, despite a series of unfavorable working conditions, on schedule in September 1954—just 15 months after the difficult job was begun.

The engineering "know-how" and the skilled manpower that American Bridge brought to this unusual project is available *anytime, anywhere*



to help you save time and money on any job involving the fabrication and erection of structural steelwork. For a detailed discussion of your plans, contact the office nearest you.



Bridge contains 6,084 tons of structural steel, consisting of:

One Through Cantilever Truss structure, 1,584′ long, composed of two 360′ Anchor Spans, two 252′ Cantilever Arms, and One 360′ Suspended Span. Cantilever structure weighs approximately 2,700 tons.

Four Deck Truss Spans 289′-3″—two flanking each end of cantilever structure.

Twelve Deck Plate Girder Spans 140′ long—six in each approach.

Twelve Deck Plate Girder Spans 100′ long—six in each approach.

Total weight of structural steel is 6,084 tons. Weight of I-Beam-Lok open-type steel flooring is 238 tons.

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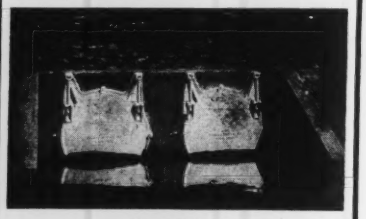

Fig. B-124-D

Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

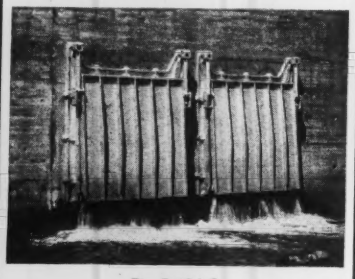

Fig. B-124-C

Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

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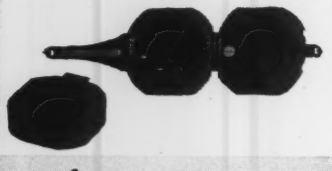

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News of Engineers

(*Continued from page 24*)

Harold B. Gotaas, professor of sanitary engineering and chairman of the civil engineering division at the University of California, received an honorary Doctor of Science degree from the University of South Dakota, in recognition of his contributions in the areas of engineering, public health, and international cooperation for economic development.

Lyle E. Seeman was promoted from the rank of Colonel, Corps of Engineers, to Brigadier General this July. General Seeman has been division engineer of the Corps' Southwestern Division since September 1954 supervising a program of military construction in five states, and a civil works program in eight states. He had previously been district engineer for the Alaska District and has worked for the Central Intelligency Agency. His home is in Dallas, Tex.

L. E. Seeman

J. D. Hancock, formerly with Knappen-Tippetts-Abbett-McCarthy-Stratton Engineers on a project in Ankara, Turkey, has been transferred to the company's office in Salihli, Turkey, for work on the Demirkopru Dam there.

Robert W. Shaffer has become a partner in the firm, Edward L. Varney Associates, Architects and Engineers, Phoenix, Ariz. Mr. Shaffer is in charge of administration and structural engineering. Previously he was executive vice-president of the Presan Corp. of Los Angeles, consultants to structural engineers.

Ernest M. Bowles, who has been with International Engineering Company of San Francisco on the Seyhan Dam project in Adana, Turkey, has been transferred to Indonesia. In the same company **Archie A. Stone** has been promoted from civil to chief engineer replacing Mr. Bowles, and **Robert B. Pechner** has become senior field engineer on the same project.

Raymond M. Rogers, for the past three years city engineer of Arcadia, Calif., has resigned to accept a position as plant and track superintendent of Santa Anita Race Track in Arcadia for the Los Angeles Turf Club. Mr. Rogers has been city engineer of Ventura, Calif., and prior to 1952 was associated with Clyde C. Kennedy, consulting engineer of San Francisco.

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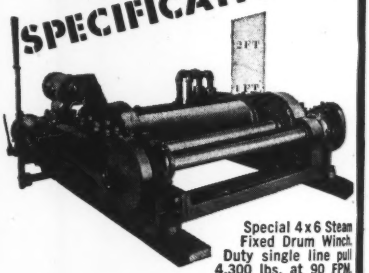

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Roy F. Weston is resigning as sanitary engineer for the Atlantic Refining Company, Philadelphia, to devote full time to his consulting firm, Weston, Eckenfelder and Associates. For the past sixteen years, Mr. Weston has been in charge of Atlantic's waste control program and, in addition, has been consultant on many types of industrial wastes problems. His firm, formerly called Weston, Eckenfelder, and Hood, will maintain an office in Newton, Pa., where Mr. Weston will be located, and an office in Leonia, N.J. The firm specializes in surveys, research, pilot plant development, process engineering and operation control.

Wayne F. Snapp, formerly an engineer with the R. J. Daum Construction Co., of Los Angeles, has been appointed general purchasing agent for the William J. Moran Co. at Alhambra, Calif. Mr. Snapp has had various positions in the construction industry here and abroad.

James E. Travis has been promoted from assistant manager to manager of the Atomic Energy Commission's Hanford Operations Office, Richland, Wash. Mr. Travis, who has been acting manager since June, has been associated with the atomic energy program for more than twelve years.

Alfred H. Ashworth, consulting engineer of North Vancouver, B.C., and specialist in the planning and design of public works projects, has just returned from New Zealand where he was engaged on the $7,000,000 eastern foreshore development program of the Auckland Harbour Board. Mr. Ashworth and several other professional engineers have formed an association to be called "North Western Associated Engineering Consultants" with several offices in Canada.

Lawrence C. Petersen, of Trenton, N.J., has been promoted to acting director and chief engineer of the bridge division of the New Jersey State Highway Department. Mr. Petersen has worked for the department since 1919.

Thomas C. North, of Zelienople, Pa., was recently elected vice-president of the Pennsylvania Society of Professional Engineers. Mr. North is chief engineer of the Universal Manufacturing Corp. at Zelienople.

Carl E. Kindsvater was one of three engineering faculty members of the Georgia Institute of Technology honored by the Board of Regents of the University system of Georgia by appointment to the position of Regents' Professor, effective this fall. Professor Kindsvater joined the Georgia Tech. faculty in 1945. In addition, he has established one of the finest hydraulics laboratories in the country.

Edward W. Backes has been appointed manager of sales for the St. Louis district of the United States Steel Corp. With U.S. Steel since 1940, Mr. Backes has been manager of sales for the Chicago district railroad division since 1947.

M. de la Torre

Mario de la Torre, for the past ten years with F. H. McGraw & Co., New York City engineering and constructing firm, opened consulting offices this July. The main office is located at 610 N. E. Terrace, Miami, Fla., and other offices are in Quito, Equador, Cali, Colombia, and Seoul, Korea. Recently Mr. de la Torre was assistant deputy project manager and superintendent for the McGraw Co. on the AEC's Paducah, Ky., project.

Charles E. Schaffner, professor of civil engineering and assistant dean of the Polytechnic Institute of Brooklyn, has been elected a member of the executive committee of the Educational Methods Division of the American Society for Engineering Education. He was also elected Evening Engineering Education Division representative on the General Council of the Society for a two-year term.

T. A. Berrigan

Thomas A. Berrigan has retired as director and chief engineer of the Boston Metropolitan Sewerage Works to open an office for the practice of law and engineering. He will continue as chairman of the Merrimack Valley Sewerage Board. Mr. Berrigan was formerly senior engineer with the Boston Transit Department. His office will be located at 20 Providence St., Boston 16, Mass.

Several Society members who have been engineer reserve officers in the Public Health Service were recalled to service this summer in a P.H.S. defense program. All are college professors in some grade: **Robert E. Stiemke,** Georgia Institute of Technology; **John D. Eye,** Virginia Polytechnic Institute; **Ely J. Weathersbee,** Oregon State College; **Jasper K. Roberts,** Missouri School of Mines and Metallurgy; **Quintin B. Graves,** Oklahoma A. & M. College; **Ellwood R. Hendrickson** and **John E. Kiker, Jr.,** University of Florida; **George W. Reid,** the University of Oklahoma; and **Gerard A. Rohlich,** University of Wisconsin.

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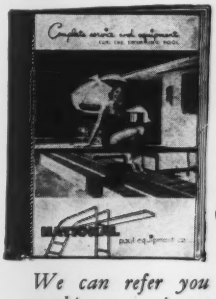

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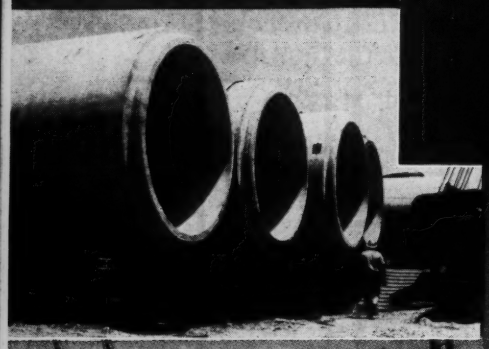

Temporary trestle provides runway for gantry crane. Pipe sections are lowered into position through trestle.

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do you know that

Major industries foresee a bumper year, both production and sales wise? Secretary of Commerce Sinclair Weeks, reporting a mid-year survey of 400 leading industries, reports that all-time high production and sales records are expected in 1955. At the turn of the year the steel, automobile, construction, chemical, rubber, and other industries had far exceeded the optimistic forecasts made for them at the start of the year.

The issue of more and better roads is not dead despite Congressional scuttling of the President's Highway Plan? In the Washington column the Society's Field Representative analyzes the causes of the defeat and gives reasons for believing that the issue is due for early revival. The place of toll roads in the expanded highway program is currently discussed in an article by T. J. Cambern.

The $20,000,000 causeway linking Cape Breton Island and Nova Scotia is finished? Three years in the making, the artificial isthmus carries a two-lane highway, a single railway track, and a pedestrian walk 4,500 ft across the turbulent Strait of Canso. It consists of 10,000,000 tons of rock obtained by tearing down a mountain.

Army Engineers are helping in the flood-stricken Northeast? To guide the work of recovery from the $1\frac{1}{3}$ billion damage caused by August floods in Pennsylvania and New England, the Army has assigned engineers from the Fort Belvoir, Kansas City, and Omaha Districts to the areas. Restoration of water supplies and sanitary facilities comes first. Bailey bridges up to 90 ft long will pinch hit temporarily for many structures swept away in the floods—the most disastrous in the history of the area. Our own printer, the Mack Printing Co., had to shut down for three days when the rampaging Delaware flooded out Easton's main pumping station and industrial use of water was prohibited.

Crude oil flow may be used to develop electrical energy? In Bolivia, where oil is more plentiful than water, plans are under way to provide electricity for a city of 30,000 by means of a "petroelectric" plant that will use an impulse turbine in an oil pipeline stream to drive a generator. John H. Williams, M. ASCE, president of a Tulsa, Okla., pipeline construction firm, is credited with the idea.

Work is about to start on a new ASCE membership directory? Watch the October issue for a coupon to facilitate reporting your correct address for the membership listing—the first since January 1954.

Only 60 percent of the membership have signed up for membership in the Society's thirteen Technical Divisions? Any member may have for the asking a recent Directory Supplement of Division members. If your name is not on the list, you miss receiving your free quota of "Proceedings" papers.

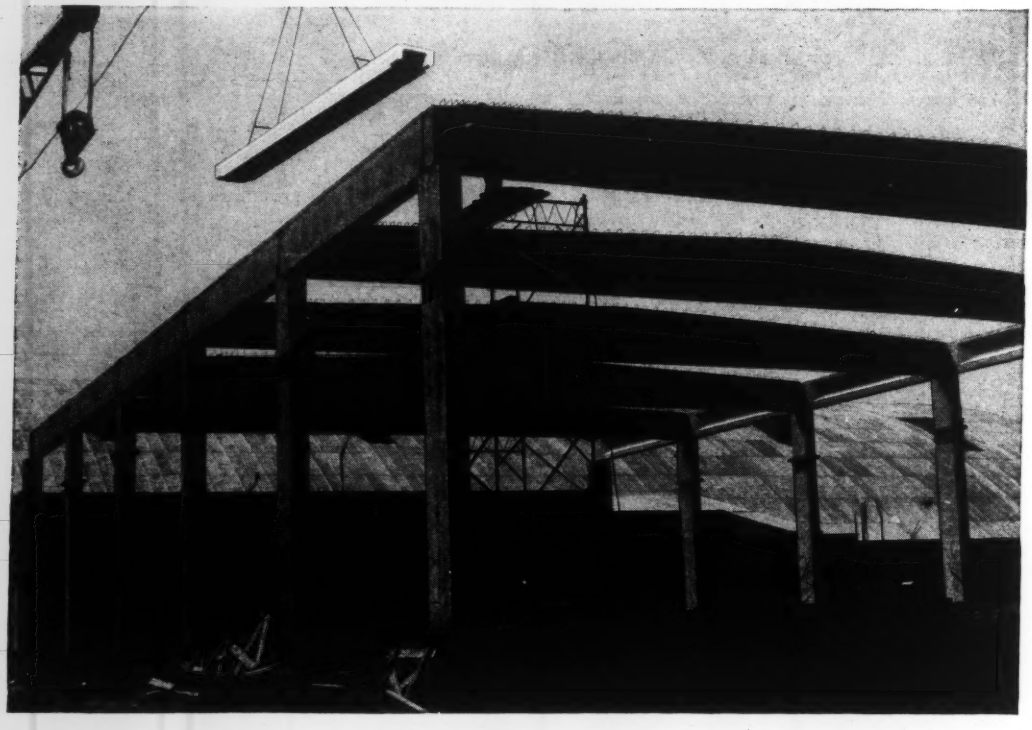
There is a demand for roads in Asia? The marked increase of motor vehicles in the Far East has created a demand for more and better roads, says the July issue of "World Highways," publication of the International Road Federation. In Japan, where some thirty toll roads are under construction, the number of motor vehicles has increased from 156,000 in 1946 to a current 1,300,000. Both India and Pakistan have long-range road programs totaling many hundreds of millions.

There are new ASCE recommendations on the professional advertising situation? Results of studies made by the Society's Committee on Professional Practice in an effort to iron out conflicts between professional advertising and the Code of Ethics are reported in this issue by Herbert C. Gee, member of the committee.

A new working committee on the E. S. Center Building has been organized? Important steps have been taken to select a site for the Engineering Societies proposed new home, with selection of the "Committee of Fifteen" authorized by the Board of Direction in St. Louis and since approved by the governing bodies of the other societies concerned. New developments are discussed on page 72.

There will be a special October issue? The twenty-fifth anniversary issue will review a quarter-century of progress in the civil engineering field. Watch for it.

75-FT. PRECAST, PRESTRESSED 'INCOR' CONCRETE GIRDERS USED IN UNIVERSITY OF MARYLAND SWIMMING POOL WING



PREFABRICATION... *summa cum laude*

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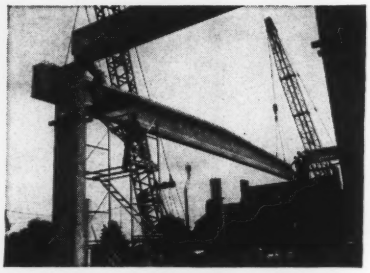
Precast, prestressed girders for this 75′ x 140′ Swimming Pool Wing to the Athletic Activities Building at the University of Maryland are 75′ long, 36″ deep at ends, 4′ 7″ at center, average depth-to-span ratio approximately 1:20.

All other structural members—the 14″ x 32″ x 23′ columns, 14″ x 36″ x 23′ spandrels, and the 10″ x 24″ x 23′ channelcrete lightweight roof slabs —are precast reinforced concrete.

Designed for span and load, these factory-made members were produced to closest tolerances by the Formigli Corporation, Berlin, N. J., for fast erection—"field practical" is the term for it. Prefabrication with a *summa cum laude!*



UNIVERSITY OF MARYLAND; Swimming Pool Wing

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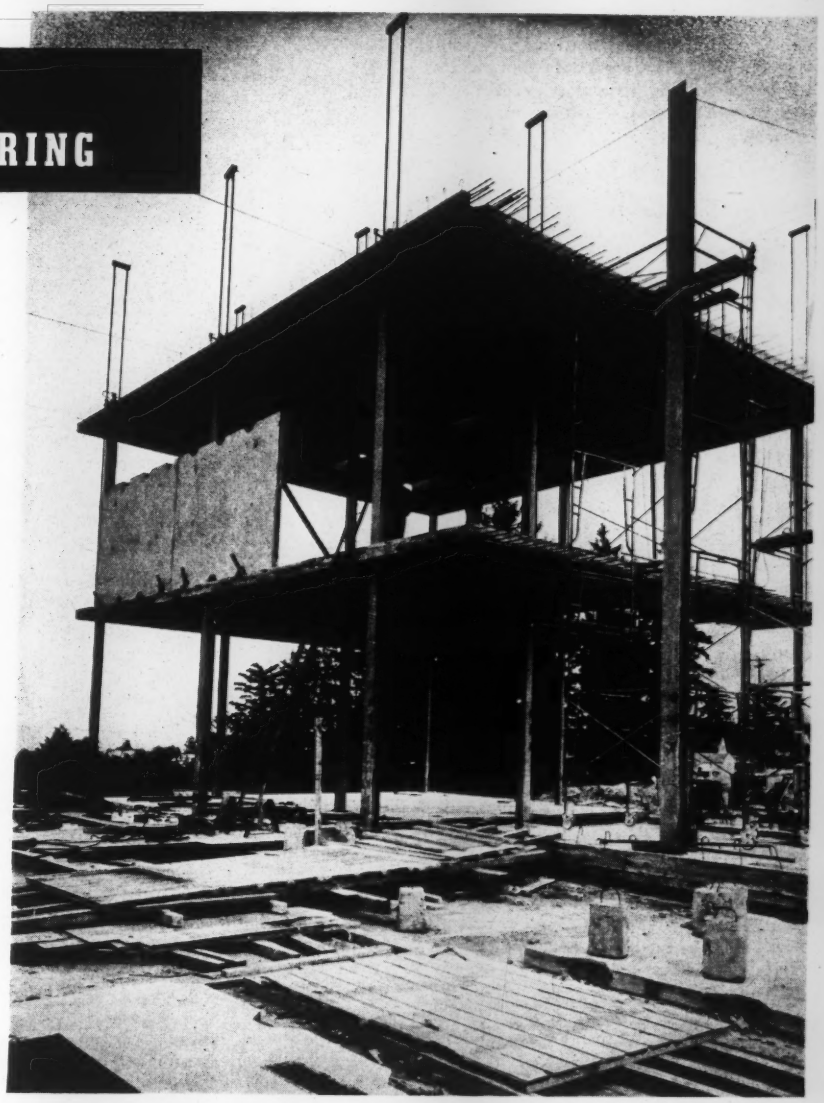


Low bidder chooses Lift Slab for high school

R. EVAN KENNEDY, A.M. ASCE

Chief Engineer, Edmundson, Kochendoerfer and Kennedy, Architects and Engineers, Portland, Ore.

The first Lift Slab design in the Portland, Ore., area did not scare off the contractors. The three low bidders all bid the Lift Slab option at savings of over $15,000 to the owners of the Woodrow Wilson High School (Fig. 1.) Subcontract for the lifting ran under $40,000 for about 140,000 sq ft of slab. Total contract for the school was $3,210,000.

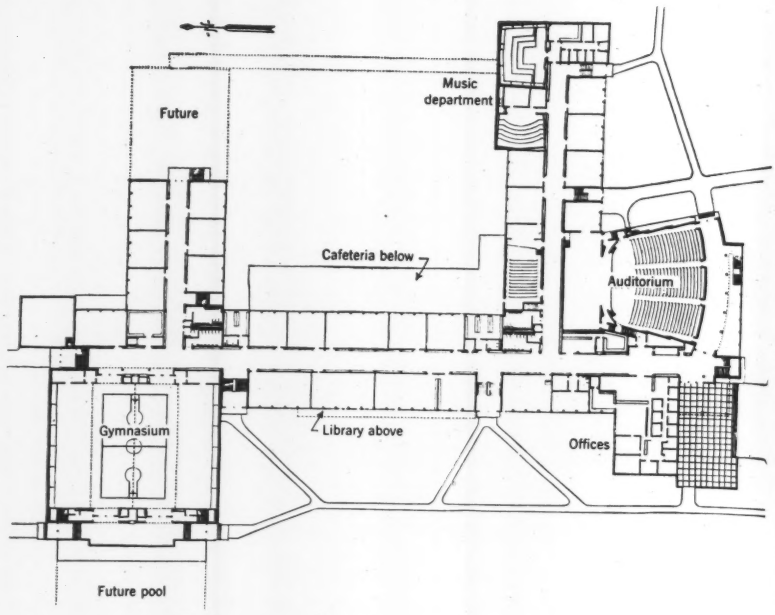


FIG. 1. Main-floor arrangement of Woodrow Wilson High School, Portland, Ore., is shown in plan. There is a story above and a story below this main floor, except in auditorium office area, which has no story below it.

The school, with overall dimensions of 440 × 570 ft, has four basic elements:

1. Three stories of classrooms and library are on lifted 10-in. flat plates spanning up to 29 ft and totaling some 140,000 sq ft in area.

2. An auditorium seating 1,372 on the main floor and balcony is housed beneath gypsum deck on steel trusses spanning from 74 to 100 ft, with poured concrete side walls faced with brick.

3. A gymnasium 134 × 122 ft is under a steel-deck-and-truss roof system consisting of steel joists spanning 52 ft to the two carrying trusses 20 ft apart spanning 102 ft, and enclosed by a tilted up concrete panel wall 32 ft high.

4. An enclosed swimming pool and outdoor wading pool is to be added later under a separate contract.

Shear walls raised with slab

Of particular interest is the use of Lift Slab and its accompanying precast shear-wall placement. The slabs are of 3,000-psi concrete made with rock aggregate, while the precast shear walls are made with expanded shale aggregate, also of 3,000-psi strength. Since the outside wall of the classrooms consists of glass windows and porcelain panels, most of the shear is taken by the interior shear walls. These light-weight precast shear walls were placed on edge in their final position on the slabs by fork lift prior to lifting and then raised with the slab. See photo on preceding page. Around stairways, reinforced grouted brick masonry is used, and poured shear walls occur at some locations.

Steel collar castings around each column are cast into the concrete. The concrete is reinforced against diagonal shear by inclined V-shaped stirrups welded to reinforcing around the castings. The castings are supported after lifting by four steel shear pads or plates which are welded to the sides of the columns. Columns are of two sizes. Exterior columns, $6^1/_2 \times 6^1/_2$ in., are made up of two angles $6 \times 6 \times {}^3/_4$ in. Interior columns are $8 \times 8^3/_4$ in. and are made up of two angles $8 \times 8 \times {}^3/_4$ in. Both are assembled by welding continuously along the toe, forming a box. Continuous welding was cheaper than intermittent in this case, and also prevented the occurrence of possible stress concentrations at welding terminations.

Special attention was paid to the setting of the column bases into the footing structure. Since Lift Slab construction loads the column at the top, the dead weight of the slab is applied at a time when the unsupported length of the column is the greatest. Hence the lower end of the column is designed to resist rotation as solidly as is feasible. To accomplish this, an anchor bolt was set on each side of the column and the column plumbed by means of leveling nuts. When plumb, the base was dry-packed, and the whole base assembly encased in a poured block which is anchored to the footing below with dowels.

Shear bulkheads prevent differential settlement

Since the building is on compressible soil, considerable study was given to the footing design. Because of closely spaced isolated column footings, steps had to be taken to control inter-footing settlement resulting from differentials between live and dead load on the structure above. This is done by placing concrete shear bulkheads 4 ft deep between all isolated footings which are closer than 14 ft apart. In instances where column footings occur under poured concrete walls, as opposed to the precast walls, the problem of settlement is somewhat different. In this case, the column is loaded early in the construction period, and relatively rapidly, by the slabs as they are lifted and positioned, causing the soil under them to compress. Later and slower loading from the poured walls is added as they are built up. To prevent the wall load from pushing the column footing further down, a settlement space of 2 in. is provided between the bottom of the walls and the top of the column footings, and the walls spanned over to the wall footing on each side of the column footing.

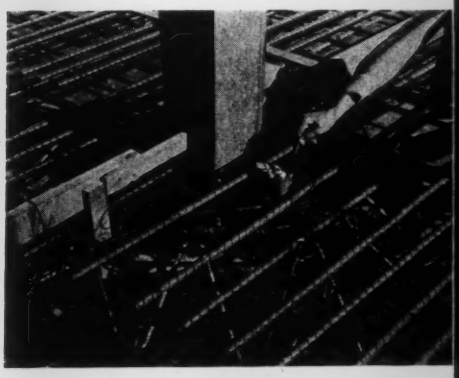
The detail of the slab collars supported by shear pads at the column received considerable attention. The original design called for the pad to be bolted for erection loads only, then welded. This was abandoned, however, in favor of all welding, since prelocated bolt holes have too frequently proved to be so far away from the final desired place as to make them unusable, because of settlement and other variables.

Uniform bearing of shear collars

It is very important that these small columns receive little more moment than that received from differential live loadings. Relatively uniform bearing of the shear collar on all four pads is therefore essential. This is provided in two ways. First, at the time of posi-

Because of compressibility of soil, shear bulkheads 4 ft deep are placed between all isolated footings less than 14 ft apart.

Cast-steel lifting collars are cast into floor slab. V-shaped stirrups take diagonal shear at collar. Interior columns are 8 × $8^3/_4$ in., made up of two 8 × 8 × $^3/_4$-in. angles continuously welded.



Slots are left in slab to key in shear walls, as shown in photo at right.

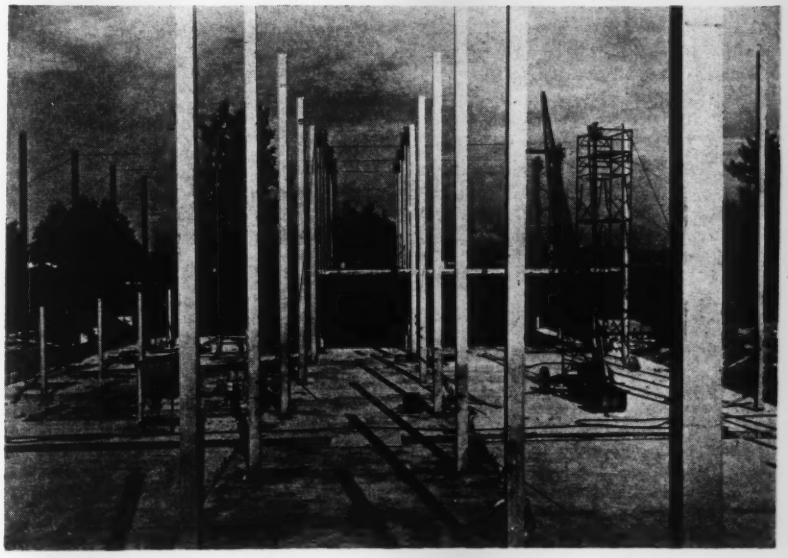
Building of Woodrow Wilson High School in Portland, Ore., involved lifting of about 140,000 sq ft of slab. Contract for lifting ran under $40,000. Slabs are of 3,000-psi concrete made with rock aggregate.

tioning of the slab, only three shear pads are welded to the column. The one adjacent to the long span is omitted and no welding is done between shear pads and collar. Second, in a minimum of 60 days the fourth pad will be added and welding then added between all pads and the cast collar. This permits the long 29-ft bay to assume a near-final deflected position without putting moment into the columns from collar rotation caused by creep and settlement.

To verify the condition of the critical columns, electric strain gages were installed on representative columns at critical sections. These were read at the time of erection, and were used in checking stresses from lifting, guying, and wind. They will ultimately be terminated in a jack set in the fireproofing where they can be read from time to time.

The architect-engineers for the project are Edmundson, Kochendoerfer and Kennedy, for which the writer is chief engineer. Homer Wong, J. M. ASCE, was design engineer. The general contracter is Hoffman Construction Co. of Portland, Ore. Subconstractor for lifting was the Northwest Lift Slab Co. of Spokane, Wash., and Portland, Ore.

The project is being constructed for School District No. 1 of Multnomah County, with J. W. Edwards as Superintendent and L. J. Baker as Business Manager.



G. C. ERNST, M. ASCE

Chairman, Department of Civil Engineering
The University of Nebraska, Lincoln, Nebr.

PLASTIC AND ULTIMATE LOAD THEORY

should be included in teaching of structural analysis

Structural analysis is based on the physical properties of materials; its method is mathematical; its purpose is design. It came into existence by a meeting of physics, mathematics, and engineering," wrote the late Dr. H. M. Westergaard, M. ASCE, well-known specialist in this field.

In the light of this definition, it should be evident that theories developed in the fields of physics and mathematics do not become methods for structural analysis until engineers study, test, and accept them.

It was not until the last half of the nineteenth century, roughly a hundred years ago, that the action of simple trusses and simple beams was fully understood, following which structural analysis as a tool began to be recognized.

During the early efforts to develop principles, and no doubt as a result of an alert intuition, there came a growing recognition that the relationship between stress and strain plays a dominant role in the determination of the proportions of a structure or structural member. Furthermore, during the same period the testing of materials was rapidly developing an understanding of the stress-strain relationship in so far as tension and compression are concerned. In examining the period from 1850 to 1900, it is evident from the published record that any one of three different trends might have developed in the selection and use of available theory and testing data. For purposes of illustration, the problem of axial compression, solved by Leonhard Euler in 1757, has been selected to demonstrate the three possible trends.

As shown graphically in Fig. 1, the linear stress-strain concept limits the development of design formulas to the straight-line portion of the stress-strain curve, whereas the non-linear concept utilizes the entire curve. The empirical concept is based on the use of a curve fitted to test results If it is assumed that the elastic and proportional limits of materials are for all practical purposes the same, then the first two concepts applied to design are generally identified as elastic theory and plastic theory. The empirical concept may be considered an ultimate-strength theory.

Early trend toward elastic theory

During the early studies of structural problems, many contributors recognized that no solution was complete unless conditions at actual failure had been considered; hence Coulomb's contention in 1776 that the neutral axis may be in a different position at rupture. However, by the close of the nineteenth century, the apparent simplicity of the linear theory when used with the assumption of an isotropic material became too appealing for many to resist, and the trend in the first half of the twentieth century was overwhelmingly in favor of the linear or elastic theory.

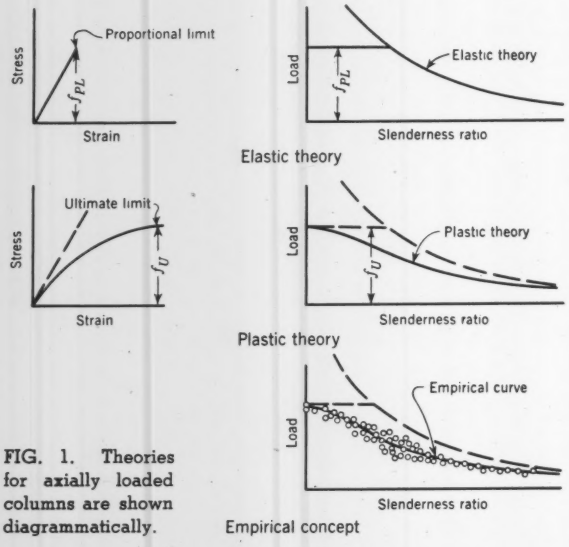
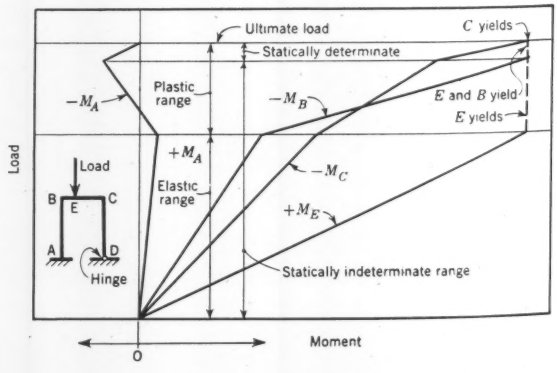


FIG. 1. Theories for axially loaded columns are shown diagrammatically.

FIG. 2. Moments for rigid frame, with free sidesway, are shown throughout entire stress range.



Nevertheless, this wide acceptance of the elastic theory did not prevent good judgment from prevailing when safety was endangered, as in the case of column analysis, for which the elastic theory may provide dangerously high values. See Fig. 1. Furthermore, the theory of reinforced concrete during its development stage, at the beginning of the twentieth century, was treated by both elastic and plastic theories. The textbooks on reinforced concrete during the early years of the current century generally covered both concepts, although the emphasis was placed on the elastic approach for design.

However, by the close of World War I, in so far as undergraduate instruction in structural analysis was concerned, only columns and riveted joints remained outside the fold of elastic theory. Structural education had settled into a comfortable routine of instruction in elastic theory and observance of specifications. During the past three decades, literally thousands of engineers must have been graduated with the erroneous impression that the so-called elastic method of analysis was the only correct and accurate method.

A review of the technical literature of the past thirty years does not disclose the same complacency on the part of those contributing to the advancement of structural analysis and design. It is difficult to find any recognized authority on elastic methods during this period who did not investigate some structural problem by plastic theory. The two theories have always been tools of equal significance and value to those interested in the study and development of structural analysis, but it has been only within the past few years that the plastic theory has been given serious review and consideration by the majority of structural engineers in this country. In 1936, the ACI Building Code deleted n in the design of axially loaded reinforced concrete columns, and changes based on the "Theory of Limit Design," by J. A. Van den Broek, M. ASCE (ASCE *Transactions*, 1940), have already been introduced into the AISC Specification for the Design of Structural Steel for Buildings. Several recent textbooks on reinforced concrete include a summary of the "Plastic Theory of Reinforced Concrete Design," by C. S. Whitney, M. ASCE (ASCE *Transactions*, 1942).

Rise of two factions

Unfortunately, two factions appear to have developed, one in favor of the elastic theory as the primary tool of structural analysis, and the other in favor of the plastic or ultimate-load theory. Arguments presented by both factions involve the exceedingly tenuous factors of relative economy of materials and simplicity of use. The fact that seems to have escaped so many structural engineers is that after almost a century they are again on the threshold of determining the response of a structure through all the loading phases up to failure.

There can be no real justification for selecting a design procedure on the basis of whether or not a few pounds of material are saved. It is an illusory idea that a selection can be made between elastic and plastic theories. Although one may accept limit design as a justification for increasing the allowable stress at an intermediate support of a continuous beam, as in the AISC Building Code, it remains a fact that the structure will respond to load application throughout a reasonably well-defined elastic range before entering the stage of plastic yielding. It would seem self-evident that any structure should be adequately designed for both phases of response.

The limit design and plastic theory methods are merely extensions of our present knowledge of structural action into that twilight zone between the end of the elastic range and ultimate failure. To demonstrate the significance of this, results are shown in Fig. 2 from the analysis of a rigid frame proportioned to show the type of action that may occur in more complex statically indeterminate structures. The frame is fixed at A and hinged at D, and therefore has two redundant moment sections. Within the elastic range, all moments increase in direct proportion to the increase in load, with the critical section occurring beneath the load. When the section at E reaches the plastic range, the section yields without increase or decrease in moment, and equilibrium is maintained under further increases in load by a balance of the changes in moments at the sections A, B, and C.

If the yield at E is truly free, with a constant moment, the moments at A, B, and C vary in direct proportion to the increase in load. That is, elastic action is maintained except for the section at E. During this loading range, the moment at B overtakes that at C, reaching a condition of yield prior to C. With this second section developed plastically, the frame becomes statically determinate for all further increases in load up to the yield of C at which collapse occurs.

It is significant to note that the sections do not retain their same relative importance throughout loading to failure. Furthermore, the moment at A changes from positive to negative and then recedes to zero at failure of the frame. It should be evident that neither the elastic nor the plastic range should be omitted from consideration during the design of a structure. It also is evident that the inspection of failed structures for the purpose of determining the cause of failure cannot be successful with only the elastic theory in mind. For example, although section E is the critical section elastically, if it is able to yield throughout the entire plastic range, failure of the section B due to inability to yield sufficiently (perhaps because of poor detailing) would produce collapse at a load below the possible maximum and with a fracture at a section other than the critical one by elastic theory.

Teaching geared to elastic theory

In so far as courses within any accredited college of engineering are concerned, the study of structural analysis begins with courses on engineering statics and dynamics, and proceeds through courses on the mechanics and properties of materials, statically determinate and statically indeterminate structural analysis, reinforced concrete, and structural design. A careful review of these courses will reveal that at present they are geared solely to the elastic theory, in spite of the inclusion of introductory material on plastic theory in certain textbooks on reinforced concrete.

Obviously a hit-or-miss revision traveling in a sort of wave from the top down will only cause confusion and eventual regrets, but it may be the path that will be taken. An orderly, systematic revision of our entire traditional approach to instruction in structural analysis seems far more desirable. Inclusion of the problem of instability in engineering statics and dynamics would be very important, but I know of only one book that treats of it in a sound, fundamental manner. Books on strength, or mechanics, of materials are in a far less advantageous position. A coordinated treatment of both elastic and plastic properties should precede the development of any stress formulas. The elastic and plastic theories should then be presented with equal emphasis as applied to flexure, torsion, columns, and combined direct stress and bending. To my knowledge, there are no books of this type adaptable to undergraduate instruction. Equal emphasis on the two concepts should then be carried through the structural books on theory and design, rather than the present erratic emphasis by means of footnotes, inserted comments, isolated paragraphs or chapters, or appendices.

The present trend to evaluate the full action of structures up to failure is most certainly a healthy one, which should eventually assure better control in structural design.

TOLL ROADS...

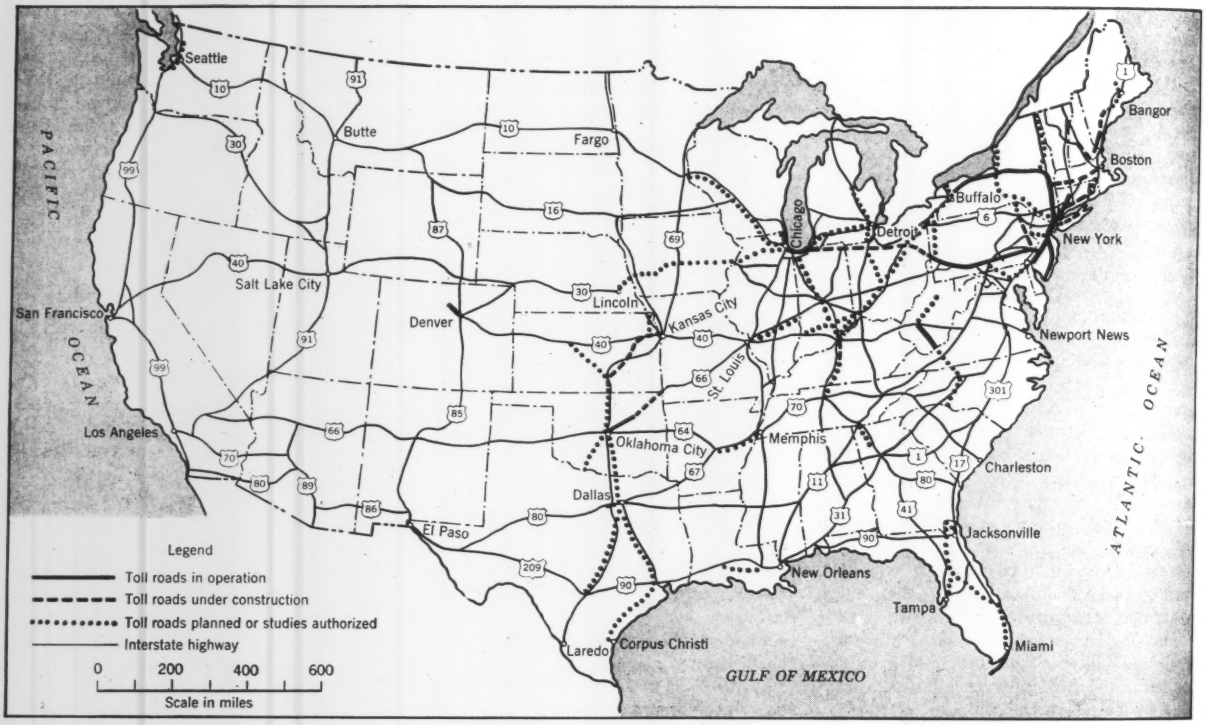


FIG. 1. Interstate System as designated in 1955 consists of about 37,600 miles of principal highways. Toll roads now in service total 1,058 miles, of which 988 miles parallel or replace Interstate routes. Toll roads under construction or financed make up 1,247 miles, of which 1,200 miles are on Interstate routes. Authorities have been set up in 17 states to plan nearly 4,000 additional miles of toll roads.

their place in the expanded highway program

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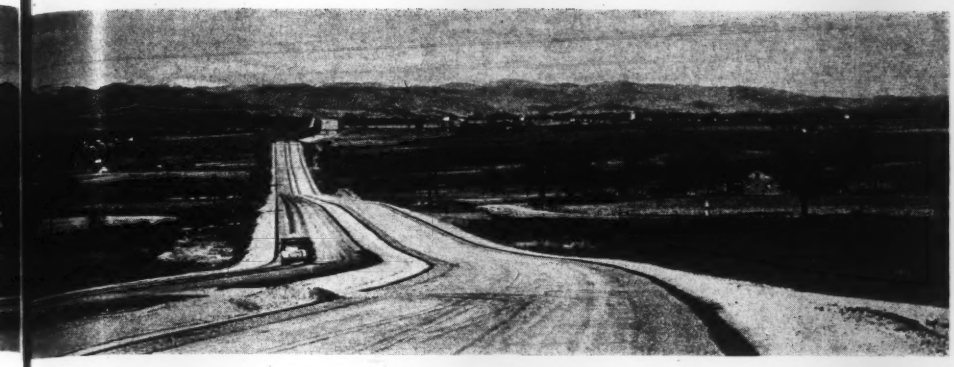


Enthusiastic acceptance of toll roads by motoring public is one of most amazing developments of recent years. Photo shows Denver-Boulder Turnpike, a toll route.

Within the past several months, a revolution has occurred in highway thought and planning throughout the country; a new concept of highway needs has become generally accepted. No longer are we thinking in terms of less than $4 billion per year as an adequate sum to be spent at all levels for new construction, or of piecemeal improvement of existing principal highways in a futile endeavor to keep pace with growing traffic needs. No longer are we unappreciative of the enormous economic loss resulting from inadequate and congested traffic facilities, or indifferent to the terrible toll exacted on highways by accidental injuries and deaths.

We are apprehensive in the realization that if we are forced into another world conflict, our highway system will be wholly inadequate for movement of men and munitions, and for evacuation of our cities under threat of atomic bombing. We have come to accept the fact that many miles of our present principal highways and streets must be abandoned, except to local travel, and be reconstructed on new locations, according to new concepts of capacity, alignment, sight distance, grade separation of intersecting facilities, and control of access. We realize that, to overcome the acknowledged deficiencies of our highway plant will require the expenditure of approximately $54 billion dollars above the sums allocated annually to new construction under current programs.

On February 22 of this year, the President transmitted to Congress the report made to him by the President's Advisory Committee on a National Highway program; this was the committee headed by Gen. Lucius D. Clay, Hon. M. ASCE, and more generally known as the Clay Committee. This report drew for its conclusions on the comprehensive studies made at the direction of the 83rd Congress by the Bureau of Public Roads and the highway departments of the several states, on contributions of the Governors Conference of 1954, of the Inter-Agency Committee of the Federal Government, of the American Road Builders Association and other associated groups, and on the thinking of leading authorities on matters of highway planning, finance and construction.

The Bureau of Public Roads, on information developed by the highway departments of the states, has estimated that the construction needs of our highway system over the next ten years will require expenditures of $101 billion, if at the end of that time it is to meet the urgent requirements of our growing population and expanding economy. This sum would be distributed approximately as follows:

Interstate System	$ 27 billion
Federal-aid primary, other than Interstate System	30 billion
Federal-aid secondary system	15 billion
Other roads and streets	29 billion
Total	$101 billion

Proposals of Clay Committee

The Clay Committee has proposed that the Federal Government provide $25 billion of the $27 billion required for the Interstate System and that it contribute $600 million annually to the states on a 50-50 matching basis for other federal-aid highways, leaving to the states and other units of government the task of finding the $7 billion annually needed to complete the program. In 1954, expenditures for new highway and street construction, at all levels, totaled $3,856 million, of which the Federal Government provided $675 million.

The Clay Committee further proposed creation of a Federal Highway Corporation which would issue and market revenue bonds in the amount of the federal contribution to the Interstate System. These would mature in 30 years and would be serviced by the excise taxes, at current rates, on motor-vehicle fuel and lubricating oil, in excess of $622.5 million collected each year. The $22.5 million is the present annual expenditure by the Government on park and forest highways. This would leave an estimated $600 million each year of motor-fuel excise taxes for annual contribution to the federal-aid system as proposed.

The Clay Committee also proposed that in apportioning funds to be applied to the Interstate System among the states, appropriate credit be given to those states in which sections of the system had been improved to acceptable standards through general revenue or toll financing, or might be improved by toll financing, provided the funds so released were used for further highway improvement.

Proposals of Gore bill

A measure had previously been introduced by Senator Albert Gore, chairman of the Subcommittee on Highways of the Senate Public Works Committee, which would greatly increase authorizations for federal participation in the financing of highway construction, but in the pattern of previous federal-aid Acts. As originally presented, it would increase grants to the states to $1.6 billion for each of the five fiscal years beginning in 1956 and would reduce the present requirement of state matching of federal funds on interstate highways from 40 percent state and 60 percent federal to one-third and two-thirds respectively. Federal funds so allocated would be distributed as follows:

Interstate System	$500 million
Primary roads	500 million
Secondary roads	325 million
Urban roads	275 million
Total	$1,600 million

Proposals of Case bill

A third bill was introduced by Senator Case of South Dakota. It pro-

poses federal expenditures of $18 billion on the Interstate System over a ten-year period, with the states matching 10 percent of the federal outlay; an annual authorization of $810 million for other federal-aid highways, with the states matching those funds on a 50-50 basis; and $90 million annually for forest highways.

Appropriations from the general revenues of the Government would provide the source of $1.8 billion of the total annual outlay. The remaining $900 million would be provided by a National Interstate Highway Right-of-Way Corporation which would issue not more than $500 million of general-obligation bonds each year for 10 years; from the sale of revenue bonds for construction of toll bridges and tunnels on the Interstate System; from toll charges, license fees on cars, trucks and buses using the interstate highways; and from rentals of rights-of-way to public utilities.

Three proposals compared

Certain comparisons of these three principal proposals, as originally presented, are of particular interest here. The Clay Committee proposal would provide federal contributions for new construction on the Interstate and federal-aid systems of $3,100 million annually, the Case bill contributions of $2,610 million, and the Gore bill contributions of $1,600 million. These compare with contributions of $575 million authorized for 1954 and of $875 million authorized for 1955. The Clay Committee proposal contemplates contributions by the states, in matching funds, of $800 million annually, the Case Bill matching funds at the rate of $990 million, and the Gore Bill matching funds at the rate of $1,350 million. These compare with funds of $512 million to be provided by the states in matching the 1954 authorization, and $817 million required if federal-aid funds available in 1955 are to be matched.

Furthermore, the Gore Bill does not permit the states to provide any part of matching funds through direct toll charges; the Case Bill appropriates the charging of tolls on highways of the Interstate System to the Government for financing its contribution; and only the Clay Committee proposal makes toll charges on highways of the Interstate System available to the states for financing their contribution to the program.

Considering the difficulty the states have experienced in matching grants available to them under current and past federal-aid programs, and in meeting their other commitments for highway purposes, it is difficult to believe that they now can find revenues to provide matching funds in the amounts contemplated by the Gore and Case proposals. Opinions recently solicited from the several state highway departments by the Bureau of Public Roads were that 43 states could find the matching funds required by the Clay Committee proposal; only 19 hoped to match funds in the amount anticipated by the Gore bill.

Since this paper was written, the Gore Bill has been passed by the Senate. As revised in Senate committee, the funds provided and the participation by the states more closely approach the recommendations of the Clay Committee. The bill now provides federal-aid funds of $12¼ billion over the 5-year period beginning July 1, 1956. Of this, $7¾ billion would be applied to highways of the Interstate System, to be matched by states on a 90 percent–10 percent basis; $4½ billion would go to other federal-aid highways—primary, secondary and urban—to be matched by the states on a 50-50 basis. The states then would be required to provide matching funds averaging $1,072.5 million annually.

Federal funds for the Interstate System would be provided at a gradually increasing annual rate as follows:

$1	billion in 1957
1¼	billion in 1958
1½	billion in 1959
2	billion in 1960
2	billion in 1961

Matching of federal-aid funds, however, is not the principal demand on state and local agency resources. Even under the liberal provisions of the Clay Committee proposal, state and local governments would need to provide an average of $6,200 million annually over the next 10 years to complete financing of new construction now needed. Maintenance and administration would require an additional $2,500 million annually. In 1954, these agencies were able to find, for all purposes including the matching of federal-aid funds, but little more than two-thirds the sum of these amounts. Their receipts included $1,922 million of proceeds from bond sales, principally toll revenue issues.

Pay-as-you-go not feasible

It would be wonderful if we could finance the accelerated program of highway and street construction now so urgently needed on the pay-as-you-go basis advocated by many, but that does not appear possible. State and local governments are, of necessity, turning more and more to credit financing to meet commitments for new construction, supporting that financing by pledges of anticipated toll or excise tax revenues.

There is a common error made in statements regarding credit financing of highway improvements that is deserving of comment here; it is in classing interest charges as a capital cost. This is admissible only if we consider improved highways to be a luxury, without earning capacity or public benefit. Interest costs of credit financing are properly an expense charge, to be balanced, together with maintenance expense and depreciation charges, against earnings or benefits. Through its contribution to increased motor travel, the well planned and adequately justified improvement will often return, in excise taxes on motor fuel alone, more than the interest charges on its capital cost. This is applicable both to toll-revenue and excise-tax financing.

There is, however, danger in the abuse of credit financing of highway improvements based on excise-tax revenues. Such financing requires commitment of tax revenues 20 years and more into the future, for payment of interest charges and retirement of bonds. This is an accelerated program of highway improvement now being considered, to overcome the lag in new construction expenditures resulting from restricted activity during the recent war years. After that is accomplished, revenues in greater amount than have heretofore been available will be needed for maintenance and for further improvement of the highway plant to satisfy the demands of continuing increase in motor travel. Excise-tax revenues committed into the future will not be available for these later needs. Toll charges assessed now to support financing of new construction will leave tax revenues uncommitted and available for normal needs.

There are many popular misconceptions of toll roads and toll-revenue financing of highway improvements to which misleading terminology has contributed. Among the principal culprits is the term "private financing" and the use of "public roads" in contrast to "toll roads." The issue and sale of toll revenue bonds for a highway improvement is no more private financing than is the sale of other governmental obligations to provide funds for the purchase of munitions, to improve city streets or to construct sewers, waterworks or schoolhouses. The sole difference is that one bond issue may be secured by toll revenues, the other by revenues from general or special tax assessments. The modern toll road is no more a private road than is the district schoolhouse, constructed from the proceeds of a bond sale, a private school. The toll road is a part of our public road system and should be so considered.

Public support for toll roads

One of the most amazing developments of recent years has been the enthusiastic acceptance of toll roads by an overwhelming majority of the motoring public, wherever it has had opportunity

to profit by them. The principal opposition to toll roads, and toll revenue financing, has not come from the motorist; he has amply demonstrated a ready willingness to pay a modest toll for the use of a superior facility—in preference to dissipating in lost time and increased motoring expense, a greater charge in travel over the usual inadequate and congested highway. The principal opposition to toll roads has come from those special interests, organized and otherwise, that have a commercial stake in maintaining the present status and condition of our highways. The perfect highway to them is one which carries a double line of motor vehicles, bumper to bumper, at a snail's pace past their places of business.

As a matter of fact, their quarrel is not with the toll charge—they are not that solicitous of the motorist's welfare—but with the limited-access feature of the toll road and with the diversion of traffic away from the locations upon which they have settled. These same interests will oppose, with equal vigor, the limited-access feature now to be required of highways on the Interstate System, and relocation of those highways to avoid the restrictions on improvement which roadside business enterprise has created.

There are now in this country 1,058 miles of toll roads completed and in operation; their cost is approximately $1.1 billion. Of these, 988 miles parallel or coincide with interstate routes. Another 1,247 miles of toll roads are under construction or are financed; they will cost an estimated $2.0 billion. Approximately 1,200 miles of these highways will be on interstate routes. Authorities have been established in 17 states to study and plan nearly 4,000 additional miles of toll roads, estimated to cost more than $4.3 billion, but recent investigations indicate that at least 914 miles of these, estimated to cost $991 million, are not at present feasible of financing.

The map, Fig. 1, shows the present Interstate System plus toll roads in operation, under construction, and planned.

The financing of a toll revenue facility solely on its anticipated earning capacity now requires that estimated net revenues from the first year's operation, after payment of all operating and maintenance expense, provide a margin of approximately 50 percent over bond interest requirements. This is a severe test. It means that estimated revenues of the usual project, with allowance for expected traffic growth, must be sufficient to pay all expense of operation, all interest charges, and to retire the entire capital outlay within less than 20 years. A modest subsidy, or guarantee of interest payments as these fall due, would reduce this margin requirement and make possible the financing of many toll revenue projects, potentially self-supporting but not now capable of making an adequate showing of financial feasibility. In this category are a possible 13,000 miles additional of potential toll highways. Their construction, together with construction of the toll revenue projects now under study, would give tremendous impetus to the program now so critically needed.

A materially expanded program for the betterment of our highways is doubtless in the making, as it must be if we are to avoid critically restricting further traffic growth and economic development in all of our densely populated areas. But it is not likely that the current deliberations of Congress will produce some magic and painless means of bridging the gap between funds now available for highway improvement and those so urgently needed, nor is it likely that Congress will propose or the public soon consent to an increase in excise taxes sufficient for that purpose. Very apparently, we must continue to rely heavily on toll-revenue financing for the early improvement of many of our principal highways.

(This paper was originally presented by Mr. Cambern at the ASCE St. Louis Convention, before the Highway Division session presided over by Harmer E. Davis, a member of the Division's Executive committee.)

Hackensack and Passaic River Bridges on New Jersey Turnpike, another successful toll route.

BAXTER W. NAPIER, JR., J. M. ASCE

Assistant Engineer, Hazelet & Erdal, Consulting Engineers, Cincinnati, Ohio

UNIONIZATION . . .

a vital question awaits an answer

At District 9 Council meeting at Purdue University on May 4, four papers on "Unionization and the Young Engineer" were given in competition for the District's Daniel V. Terrell Award. The winning paper is here presented.

The question of unionization of engineers is complicated by the fact that we are dealing with something affecting our profession as a whole. We are formulating a plan or a course of action that must take into consideration every man, from the engineer-in-training his first year out of school, to the mature engineer with his own consulting practice—from the engineer working for a contractor as one of two or three graduate engineers with the company, to the engineer with the large consulting firm or large industrial concern who may be one of several hundred engineering employees. The contractor's engineer is subjected to one sort of pressure; the engineer, one of several hundred, is subjected to other pressures and has other needs for which he would like to look to his professional organization; and the consultant, an influential man, to be sure, has pressures exerted upon him also—from clients, for example—which limit his ability to do for his engineering employees what he would like to do for them financially.

Now our goal, our task, our duty, is to evolve a policy or decide on a course of action relative to unionization which will be best for the entire group—which will enhance our profession, enable us to make a greater contribution, and raise the economic status of the individual engineer, so that we can continue to attract outstanding young men to meet the tremendous responsibilities that must inevitably confront the engineering profession in the coming years. With this complex picture in mind, I think we must agree with the ASCE Committee on Employment Conditions, which states in its interim report of March 28, 1954,

"Unionism in engineering is a very complex subject. It gets more confusing as it is probed with an open mind." (Civil Engineering, May 1954, p. 71.)

Probing it, let us consider the labor union, reasons for interest in collective bargaining, and our proposed course of action.

Anyone examining the history of the worker in the trades and crafts will be impressed by the fact that labor unions did a job that sorely needed to be done. The laboring man was being taken advantage of, but now, most of us will agree, the pendulum has swung to the other extreme and the philosophy of the labor unions, as evidenced by their performance, is completely inconsistent with the purposes of the engineer. These purposes are well expressed in the oft-quoted creed:

Service above gain
Excellence above mediocrity
Pride above monetary reward
Loyalty above individual advantage

The engineer now has statutory protection under the "professional employee" provisions of the Taft-Hartley Law. The events leading up to these provisions are illuminating. When the Wagner Act became law in 1935, little attention was paid to it by professional people. Apparently there was no realization of its impact on engineer employees, but employed engineers were just as much a part of the labor force in the eyes of the law as were carpenters, hodcarriers, or any other workers. The labor unions were quick to take advantage of the situation, and engineers soon found themselves being forced to join these unions in order to keep their jobs. Labor leaders who had little understanding of the objectives of professional people and even less concern for them, were serving as their official representatives. It was practically impossible for professional employees to withdraw from these heterogeneous unions, and their minority voice had no effect on union policy.

The ASCE formed a "Committee on Unionization" in 1937 to study conditions with the idea of being better able to give guidance to engineer employees in their sorry plight under the Wagner Act and with the further purpose of seeking a means to amend the Act.

It was technically possible, though difficult, to set up bargaining groups of professional employees under this Act. After careful examination of the facts, the ASCE worked out a method whereby a Local Section of ASCE could take the initial step toward forming a collective bargaining group composed solely of professionals. This group was completely divorced from the ASCE before being fully set up, as was necessary, since the National Labor Relations Board would have refused to approve any group sponsored, or influenced, by an organization composed of both employers and employees. The engineers' unions were formed to protect the engineer from the heterogeneous union in which he had no voice. This was the ASCE plan for making the best of a bad situation.

In pursuing its further goal of amending the Wagner Act, the ASCE through its Committee on Employment Conditions prepared a policy statement which it put forward as the proposed amendment. By this time the other professional societies had come to a better understanding of what ASCE had been doing for ten years. The policy statement of ASCE was adopted as the official policy of the Engineers Joint Council. ASEE and NSPE also cooperated in the effort, and eventually the so-called "professional employee" provisions were incorporated in the Taft-Hartley Act.

The essence of these provisions is succinctly stated by a member of the ASCE Committee on Employment Conditions:

"The essence of the professional employee provisions is that a group of professional employees, in any phase of employment may decide by majority vote of their own members whether they want to form a bargaining unit of their own for collective bargaining purposes, to join with some other bargaining group, or to refrain from any action of the sort."

Thus after a long struggle and largely as a result of the efforts of our own Society, engineers have the right of self-determination in collective bargaining. That is where we stand today. It is my opinion that, since we have at last won this position, it would

be the utmost folly for us, as young engineers, to consider putting our heads back in the noose and becoming associated with these heterogeneous unions whose objectives, in a large part, and whose methods of obtaining their objectives, are so foreign to the professional attitude.

If, however, we are to assess the situation realistically, we must admit that a lively interest is evidenced by engineers in collective bargaining. Results of a questionnaire sent out by ASCE to all its members indicate that two of every five of the 17,203 returns are not opposed to collective bargaining. By grades of membership, 43 percent of the Junior Members, 35 percent of the Associate Members, and 26 percent of the full Members are not opposed to collective bargaining.

As we seek a reason for these figures, which are surprising to many of us, we find it well summarized by Charles W. Yoder, Vice Chairman of the ASCE Committee on Employment Conditions:

"When the climate is favorable, ideas will grow and take physical form—even collective bargaining among engineers."

Let's take a look at some of the elements which combine to produce a climate conducive to such an attitude among engineers. From questionnaires sent to engineers by various organizations it seems that three factors stand out as major causes of dissatisfaction:

1. The feeling of the engineer that he is not accorded the treatment due him as a professional man. Embodied in this are the following:
   a. The feeling that he is not let "in" on what the company is doing.
   b. The feeling that the work he is given to do is below his professional talent.
   c. The feeling that his opinion is not valued, and the contribution he is given opportunity to make is not significant.
   d. The feeling that there is a lack of opportunity for professional growth.
2. A second factor is the feeling that the engineer's pay is not commensurate with his training and responsibility.

According to figures from the Bureau of Labor statistics, the pay of the engineer with 5 years of experience in relation to the median pay of skilled laborers dropped from 1.2 to 0.94 from 1941 to 1951, a loss of 21 percent in relative pay. During the same 10-year period the engineer with 15 years of experience suffered a pay loss of 35 percent. The ratio of his pay to that of the skilled laborer dropped from 1.95 in 1941 to 1.25 in 1951.

In the NSPE publication, *A Professional Look at the Engineer in Industry*, an executive of a large concern is quoted as stating in regard to the strategic position of the engineer: "Because the organization is dependent upon him and because he is entrusted with a responsibility that others in it cannot do or often even check, it is essential that the engineer be clearly aware of the ethical requirements of his profession."

All engineers will agree that a professional man should not use his position of responsibility to take unfair advantage of the employer—but the engineer's answer to this executive might reasonably be, "I believe all that you've said about my position of importance as an engineer. The question is, do you believe it? If so, show that you do by making the pay reflect the relative importance of the work of the professional engineer and the skilled laborer."

It would seem that the employee engineer with 5 or more years of experience has a legitimate cause for complaint, and I believe we are doing our profession an injury when we fail to take steps to uphold the economic position of the engineer.

3. A third factor tending to produce a climate favorable to collective bargaining is illustrated in the case of Stewart McCoy who, as is well known, refused to join the union and was the main victim of trade union coercion of civil engineers on the Ohio Turnpike.

In an editorial on the predicament of McCoy and other engineers in similar circumstances, *Engineering News-Record* says, "The employers and professional societies were telling their engineers, 'Resist, we're behind you.'" The editorial continues, "and they were, way behind." It was a matter of individual engineers' being subjected to organized pressure and needing an organization of their own to turn to for help. Such help was evidently not available.

Unprofessional treatment, low pay, need of an organization to take the part of the engineer when organized pressure is exerted—these are the more obvious causes of dissatisfaction among engineers, the more obvious reasons for the manifest interest in collective bargaining.

What shall our course of action be?

An evident truth, I think, is that interest in collective bargaining by engineers will vary directly as the intensity of their unmet needs. So it would seem that the solution should be in the form of a strong professional organization to meet the needs of the engineer, an organization with power to do for the engineer about what the AMA does for the doctor, which would include the following things:

1. Set a reasonable scale of minimum salaries for engineers below which an employer would not expect to go in hiring an engineer.
2. Enhance the profession of engineering in the mind of the general public through the various educational mediums.
3. Act with the backing of the entire engineering profession to see that the rights of any individual engineer are not violated by unions or any other organization, and also to see that the individual engineer does not violate the rights of any client.

I can envision such an organization bringing to the individual engineer and to the profession the prestige which our training and our work makes potentially ours, but which we have largely left unclaimed.

If, however, such a plan is not feasible, for some reason, or is not worked out in the near future, what should our policy be with regard to professional collective bargaining?

Leaders in the engineering field are not agreed, but the position taken by Dr. T. H. Evans, Dean of Engineering, Colorado A. & M. College, impresses me as having considerable merit. In an article in the *Journal of Engineering Education*, he says:

> "Some of us feel that the engineering collective bargaining groups are a defense measure, used in desperation when no other help was available, and if the Engineering Profession were truly unified, as is the Medical Profession, then it could give the employed engineer the help he presently feels only the bargaining groups can give him. Since the profession is not giving adequate support to the individual professionally and economically, however, one can't honestly condemn these bargaining groups for trying to pull the iron out of the fire."

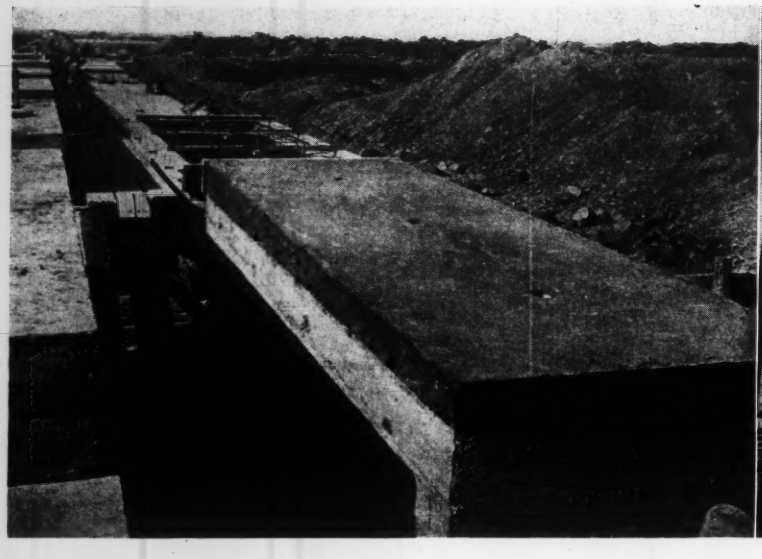
This view impresses me as being more understanding and more realistic than that of writers who say that membership in a bargaining group necessarily means the sacrifice of professional status.

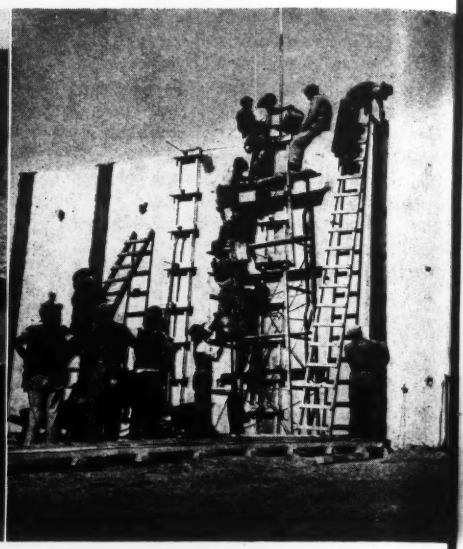
If I understand Dr. Evans, his position, and my own, is this: Our professional organization should be unified and strong enough to meet the engineer's legitimate and very real needs. But if it is not and gives no indication of becoming so—the need is still there. Is it not better for our profession, rather than merely to ignore the need, to take steps in a direction which we realize is not ideal, but which seems to be the best thing under the circumstances?

It does not strike me as being professional for those of us who are not exposed to the pressures of unionism, as are men like McCoy, to draw our robes of righteousness about us and tell him that if he adopts the only means now available of protecting himself from the heterogeneous labor union, that of joining a professional collective bargaining group, he thereby sacrifices his professional status.

I have completed this study with the conviction that this question of unionization and the engineer is a tremendously important and a very complex one. Its complexity demands, and its importance deserves, the best thought of all of us.

Big prestressed concrete tanks





Wall panels were precast at northern end of site (above left), using vacuum processing. Two sets of side forms were sufficient to cast all 294 panels for both tanks in 20 working days. As shown above, right, gaps 1 ft wide left between precast panels were filled with poured-in-place concrete, vacuum processed. Three pairs of vacuum processing forms were used for all cast-in-place joints. Temporary prestressing was started on a section of tank as soon as gaps were concreted, so that gap concrete was

Two precast prestressed concrete reservoirs, each of $9\frac{1}{3}$ million-gallon capacity, have been constructed to store the raw water pumped from the Vaal River for the oil-from-coal plant at Sasolburg, Orange Free State, South Africa. These reservoirs, built by Concrete Development Corporation Ltd., are believed to be the largest of this type in the world. The method used in their construction, which combines prestressing, precasting, and vacuum processing, was developed by the writer.

Prestressing, as is well known, finds an ideal application in circular tanks as it reverses the stresses in the wall shell from ring tension to compression. By prestressing the cylindrical wall shell, a precompression of the concrete is secured when the tank is empty, which is calculated to be slightly larger than the ring tension caused by filling the tank with water. This change of sign in the concrete stresses enables the concrete to be used in compression only, with a resulting reduction in the wall thickness required. Theoretically this thickness could be only one-fifth of that required for a non-prestressed conventional reinforced concrete tank. In actual practice, however, the saving in concrete is less because of the desire to maintain a minimum thickness and other design considerations.

In addition to the saving in concrete, there is also a saving in steel, due to the higher stresses acceptable for the high tensile wire used for prestressing. The weight of steel is only one-sixth of that required for a conventional reinforced concrete reservoir. This saving is partly offset by the higher price per ton of high tensile prestressing wire, and also by the cost of applying the outside mortar coat needed to protect the wires from corrosion.

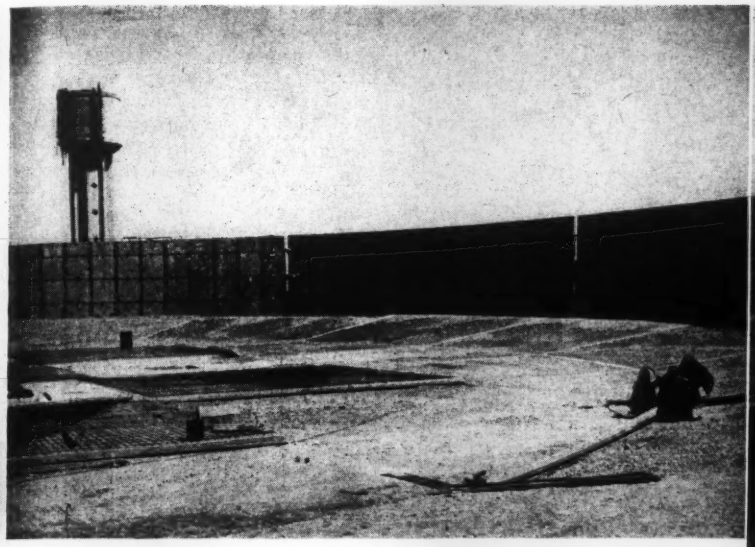
Nevertheless, in a straight comparison, prestressed tanks are cheaper than reinforced concrete tanks. Moreover, they offer a sounder type of structure, enabling the engineer to build much higher and larger structures than would otherwise be economically possible in concrete.

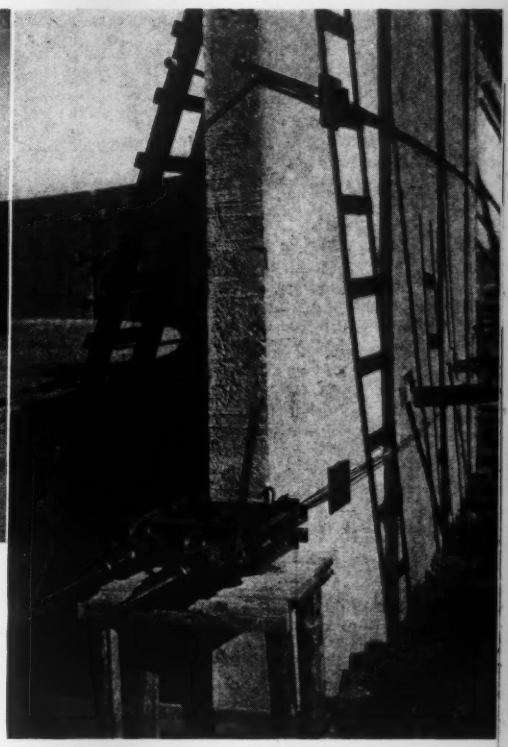
Prestressing also makes it possible to use precast concrete panels for the wall shell. Thus the tanks in Sasolburg, structurally speaking, are concrete equivalents of the wooden barrel, the wooden slats being replaced by the precast panels and the iron hoops by the high tensile prestressing wire.

built with precast panels

PETER J. DOANIDES, M. ASCE

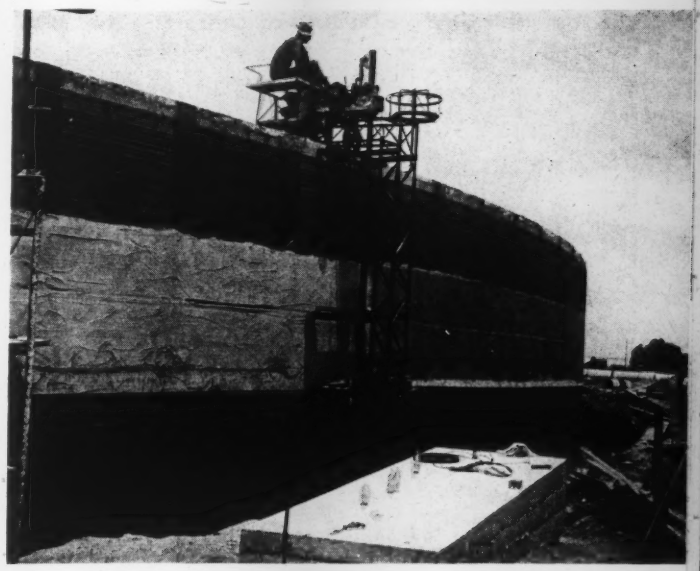
Managing Director, Concrete Development Corp.
Johannesburg, Union of South Africa





put in compression only a few hours after pouring. Above, precast wall panels are seen in place under temporary prestressing, in sections, by three pairs of "flat" cables. In photo at right, temporary prestress is being applied to lower set of "flat" cables.

In these structures the precast panels were placed on the ring beam with 1-ft gaps between them. These gaps were subsequently filled with concrete, cast in place and vacuum processed. Immediately after the gaps were cast, temporary prestressing was applied to the wall shell or segments of it so that the joints were cured in compression. Three pairs of vacuum processing forms were used for all cast-in-place joints.



Second layer of high tensile prestressing wire is being wound on bottom third of tank by machine supplied by Bureau BBR of Switzerland. Three layers of wire were wound on bottom third of tanks, two layers on middle third, and one layer on upper third. Cement mortar was applied between wire layers and on outside.

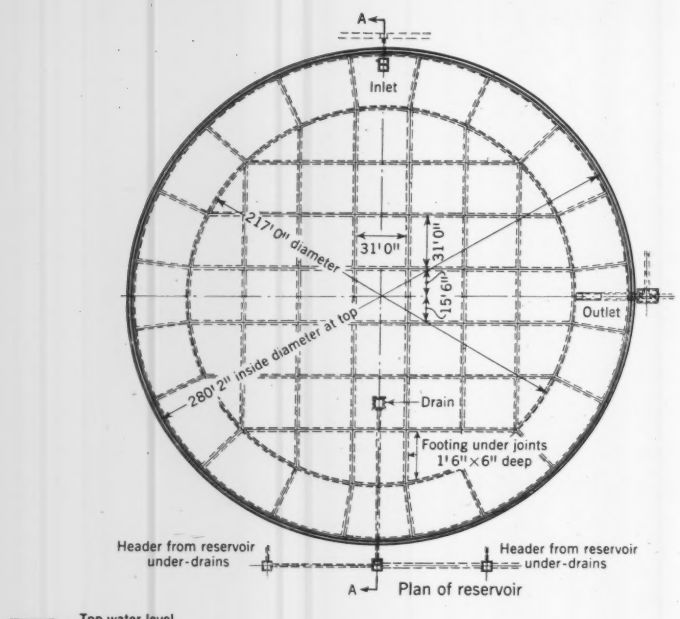


FIG. 1. Tanks, seen in plan and cross section, have wall of precast panels placed on ring beam. Conical floor, consisting of concrete panels cast in place, provides additional depth of 4 ft.

Completed tanks, believed to be the world's largest of their type, hold 9⅓ million gal each. They store raw water pumped from Vaal River for oil-from-coal plant at Sasolburg, Orange Free State, South Africa.

Use of precast wall panels not only reduces the cost of the structure but also the time of completion, since precasting of the panels can proceed while the floor is being placed.

The two reservoirs at Sasolburg have a diameter of 280 ft, a wall height of 17 ft 3 in, and a conical floor which provides an additional depth of 4 ft. See Fig. 1.

The reservoirs have their floors on rock, which is 8 ft below the ground surface. The surface soil consists of a 4-ft layer of heaving clay underlain by 4 ft of decomposed sandstone.

Excavation was carried out in two stages. First the central circle, 220 ft in diameter, was excavated to a depth of 8 ft, and an outside ring of 30 ft to a depth of 4 ft. The embankment was initially used for the transportation and erection of the precast wall panels and was then excavated to its final tapered shape after the wall panels were erected. The floor consists of 36 jointed panels, poured in place with the joints lying on concrete sills. The joints are made with a copper water stop and a 3 in. × ½ in. bitumastic seal on top.

Precast panels erected

Each reservoir wall is made up of 147 precast wall panels 5 ft wide, 17 ft 6 in. high, with a thickness of 10 in. at the bottom tapering to 6 in. at the top. A design mix equivalent to a nominal 1:2½:4 was used, and gave, after vacuum processing, an average strength of about 6,000 psi at 28 days. The wall panels were lifted from the stacks by vacuum lifters suspended from a gantry and then placed on a flat-bed truck. The truck, running on the 30-ft-wide circular embankment, distributed the panels to the locations where they were to be erected. From these points they were picked up and placed by a crane.

Final stressing was done by a BBRV tank-winding machine supplied by Bureau BBR of Switzerland. It is interesting to note that with an outside tank diameter of 282 ft, the length of wire used in both reservoirs totaled about 300 miles.

The high tensile wire was wound in three layers on the lower third of the wall, two layers on the middle third, and in one layer only on the upper third. A cement mortar layer was used between consecutive layers of wire, and the tanks were filled with water before the final outside 1-in. protective coating of cement mortar was applied.

The two reservoirs were completed in a period of 8 months, but it is believed that, with the experience gained in their construction, the time required for a similar job could easily be reduced to less than 6 months.

ENGINEERING EDUCATION—an appraisal

ADOLPH J. ACKERMAN, M. ASCE

Chairman, ASCE Task Committee on Engineering Education; Consulting Engineer, Madison, Wis.

When we attack the subject of engineering education for the civil engineering profession we find ourselves suddenly standing in front of two Goliaths—"Profession" and "Education." However, let us not create the illusion that we are about to slay both of them, or even one of them, with a single stone. These are both tremendous giants, and the problems they have accumulated are of such size and depth that, at this stage, we can at best only discuss the strategy of *how* to appraise them.

Problems of the profession

It is not feasible to make intelligent recommendations concerning future plans for engineering education before we have established a realistic concept of the profession itself—the ultimate beneficiary of such planning. The fact that today our profession is in a state of confusion and does not have the desired degree of recognition, is known to all its members. Statistical information concerning our profession and its educational facilities in engineering are readily obtained; some are presented in Table I. But we need more than cold statistics.

We can also make acceptable forecasts of the probable future demand for engineers, by correlating the census of engineers in past years with the installed capacity of electric power generation, the best index of technological development, both past and future. This offers a fairly consistent relationship which can be projected into the future with reasonable confidence. Some details of this relationship are given in Table II.

This study confirms the forecasts made by many others concerning the current and increasingly serious shortage of engineers in the future. A nationwide Convocation on Technical Manpower was held in Chicago last February 10–11, culminating in the adoption of resolutions expressing deep concern that the serious shortage of scientific and engineering personnel is imperiling our national security. Copies of the resolutions were sent to the President of the United States and to the Congress.

Many industries are foreseeing the coming crisis in the supply of engineers and have embarked on employment policies which amount to a hoarding of technically educated personnel by offering high starting salaries and rose-tinted glasses. It is a cheap investment for them, but for many promising young engineers such policies contain the elements of disappointment and professional tragedy.

One of the sharpest challenges was bequeathed to the present generation of engineers by the late Dean Mortimer E. Cooley, Hon. M. ASCE, of the University of Michigan. In his 88th year he was persuaded to write his autobiography, *Scientific Blacksmith* (ASME, 1947), in which he stated:

"For too many years the engineer has been limited, or has limited himself, to the making of the physical environment out of which have sprung the thoughts and actions of others. The engineer has played a passive part. He has been content in his field of applied science; in fact, he has gone to sleep on the job. He has been asleep nearly as long as Rip Van Winkle. . . . As matters now stand, the engineer creates the problem of his accomplishments, yet leaves the solution to the economist, the politician, and the statesman, who understand none of the technical phases of the problems. . . . The engineer must be educated to the needed changes in his training which will enable him to take over the responsibilities of leadership that, by virtue of this technical civilization, are so largely his."

The presentation of an appraisal presumes that three prerequisites have been satisfied:

1. Understanding of the basic situation
2. Wisdom to draw sound conclusions
3. Vision to make wise recommendations

TABLE I. Some statistical data on engineering colleges

For the entire engineering profession:	
Population of engineers in 1950	400,000
Population of engineers in 1955	550,000
Students enrolled in engineering colleges in 1950	190,000
First-year students enrolled in engineering colleges in 1950	52,000
Percentage of male students entering engineering colleges annually	16
Number of engineering colleges granting degrees	168
Number of major curricula offered (branches of engineering)	20
Total of faculty members in engineering	10,000
Average annual number of engineering graduates, 1952 to 1955	20,000
In civil engineering (1955 data):	
Total number of civil engineers (estimated)	100,000
Members of American Society of Civil Engineers	38,000
Colleges teaching civil engineering	137
Faculty members in civil engineering	1,500
Students enrolled in civil engineering	21,500
Annual graduates in civil engineering	3,840

TABLE II. Index of engineers in the United States

	1910	1950	1960*
Generating capacity, kw	4,000,000	69,000,000	160,000,000
Number of engineers	84,000	400,000	750,000
Ratio of kw capacity to engineers	48 to 1	172 to 1	.....
Ratio of kw capacity to industrial worker	0.28 to 1	3.0 to 1	.....
Number of engineers for each 1,000 industrial workers	6	18	.....

* Estimated.

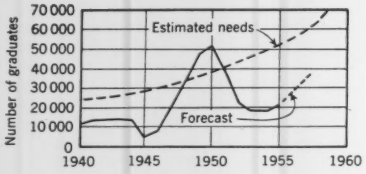


FIG. 1. Number of engineering graduates in the United States, 1940–1959, compared with estimated needs.

We must confess, at the outset, that today we are not in possession of the basic facts needed to fully understand the whole situation. Who is? Our educators? Our university administrators? The American Society of Civil Engineers? Those who could provide the financial means for building a stronger educational base for our profession? Least of all the latter! Yet, many of us are inclined to talk freely about the necessity of raising faculty salaries and incomes, increasing the number and raising the quality of faculties, expanding educational facilities, modernizing educational techniques, and in general, promoting a revolution in engineering education within the next several years.

Before we can develop broader understanding and new policies, there are many questions which call for a critical and independent examination of our profession and its educational resources, as, for example those listed in the accompanying box.

The medical profession—an example

The idea is not new of making a critical examination of a profession and formulating a comprehensive plan of corrective measures. The medical profession can serve as an excellent example.

For many years prior to 1910, medical education was in a chaotic state, and "quack" schools were flourishing. The most important incident in medical education occurred in 1910 when the Flexner Report was published which was financed by the Carnegie Foundation; this report provided a searching analysis of the profession which revolutionized the training of doctors. For example, the medical course at the University of Michigan which in 1880 had been extended from two years to three years has, since 1910, grown to the present-day requirements of four years of premedical work in a liberal arts college, four years of medicine, and one or two years of internship. The doctors themselves reformed the whole field of medical education and raised their profession to the highest on the professional ladder. By comparison, when the curriculum in civil engineering was established in 1853 at Michigan, the course required four years for the degree of civil engineer. Since that time the content of the course and the degree have been modified, but not the four-year period.

Today, the medical profession still does not consider itself in an acceptable position. Some of the current problems in medical education are as serious as we find in the engineering colleges. In 1948 the American Medical Association started a new campaign and convinced our industrial leaders of the need for assisting medical education in the interest of our national well-being. In 1951, the National Fund for Medical Education was established, which now has a Managing Director and thirty employees with headquarters in New York. A goal of *annual* tax-free contributions from industry was established at $10,000,000. The assurance of industry and national leaders has been obtained that this is a feasible goal, and a substantial part of it already has been subscribed.

Numerous other examples on a lesser scale may be cited where large corporations have had independent analyses and reports made, on which to base their decisions for adopting new policies, or revising existing ones. For this purpose they have generally engaged independent management consultants. The more experienced of such consultants have developed a high degree of competence in the techniques of analysis, in sifting out the vital facts from a mass of details, and in making skillful presentations of their findings. In the final analysis, such an approach is employed every day by civil engineers who are retained to examine problems and submit reports.

Need for independent analysis

Perhaps someone will be able to show that practically every conclusion which an independent analysis may contain has, in the past at some time or other, been presented or considered. We have had great leaders in engineering education who have dedicated their lives and talents to this cause, and who have for years been attempting to show the way. Many papers have been published by distinguished educators and deans of our engineering colleges. The names of Mortimer E. Cooley, W. E. Wickenden, Robert E. Doherty, and others stand as milestones on the road to promotion of better engineering education.

Some of the ideas for improving engineering education, which are currently being advocated, were proposed by a conference of deans of engineering in 1922, and in various comprehensive committee reports released by the American Society for Engineering Education (and its predecessor society) at various times in 1929, 1933, 1940 and 1952.

In an unprinted discussion at the Centennial of Engineering in 1952, Dean S. C. Hollister, M. ASCE, reviewed the past studies and commented on the investigations made from 1920 to 1929 as follows:

"We are struck with the potency of the statements (then) made of today's situation—and the extent of the failure of the schools to implement much of the recommendations."

After his sixty years of experience in this field, Dean Mortimer E. Cooley concluded:

"It will be clear that I have no confidence in engineering educators, through their own organizations, to provide for the needs which to me are self-evident. I have come to the conclusion that the engineering educators cannot solve the problem; perhaps it is too close to them. The change in engineering will have to come from the profession itself. The means for the change lie in the hands of the professional societies and of industry."

Action of ASCE

The Board of Direction of ASCE has recognized the advisability of making an independent analysis. Late in 1953, it appointed a Task Committee on Engineering Education which held its organizational meeting in Chicago on April 5, 1954. The Board directed that the Task Committee be formed from among members of the Society, three of whom would be named by the Committee on Engineering Education, and three by the Technical Procedures Committee, preferably not from the field of education. The Society members who agreed to serve on this Committee are the following:

Prof. F. B. Farquharson, Director, Engineering Experiment Station, University of Washington, Seattle

Prof. Nathan M. Newmark, Research Professor of Structural Engineering, University of Illinois

Prof. John B. Wilbur, Head of the Department of Civil and Sanitary Engineering, Massachusetts Institute of Technology

Adolph J. Ackerman, Consulting Engineer, Madison, Wis.

Harvey O. Banks, Assistant State Engineer, California Division of Water Resources, Sacramento

Admiral Kirby O. Smith, Atlanta, Ga. (replacing C. P. Conrad of Davenport, Iowa, original appointee who was obliged to resign because of illness)

Mr. Ackerman was elected chairman, and Professor Newmark, secretary, of this Committee.

The Task Committee is further strengthened by two advisers:

Prof. W. S. Evans, Head, Department of Civil Engineering, University of Maine, and Chairman, ASCE Committee on Engineering Education, and Contact Member of that Committeee

Dean F. M. Dawson, College of Engineering, State University of Iowa, Contact Member of the Board of Direction.

The Task Committee has devoted itself actively to its assignment and submitted specific recommendations to the Board at its meeting in San Diego in February 1955, which resulted in unanimous Board approval authorizing the Task Committee to prepare a plan for financing a comprehensive survey and analysis of the civil engineering profession and its educational problems, the emphasis to be particularly on the subject of civil engineering education. Such a survey would require at least a year and would call for a very substantial sum of money. Financial help is being sought.

One of the questions which is bound to occur to all those interested in the general field of engineering education is: Why not make this survey cover the entire engineering profession? This matter has received careful consideration and it was decided to undertake a critical examination of the civil engineering branch alone for three reasons:

1. A limited examination of one branch will permit a clearer definition of specific problems.

2. A clear definition of the problems will facilitate the mechanics of making a detailed study of civil engineering education in relationship to the needs of the civil engineering branch of the profession. This, in turn, will make it more feasible to define the financial needs for making such a study.

3. This approach may well serve as a pilot project; the experience gained from it, as well as a number of important conclusions, will be of direct benefit to the other branches of the profession in undertaking similar studies.

If we succeed in our objectives of having such a study made by professional analysts who are suitably guided by an advisory committee or, perhaps, by several such committees drawn not only from among the leaders of our profession but also from leaders in industry and government, the results will become available at the earliest possible date and in such form that they will be recognized as authoritative.

Conclusions and recommendations must of necessity wait until the facts have been assembled. Furthermore, such facts and recommendations must be presented to the entire profession in such a manner that they will command the requisite attention and response.

What can we expect from the proposed report?

First of all, we will have a dependable background of facts and information on which to develop answers to most of the questions previously stated and to others as well.

Second, the report will develop a greater awareness within our profession of the seriousness of some of the current problems in engineering education. If the danger signals are clearly presented, a substantial part of our profession can be activated to adopt corrective measures.

Third, it should provide the means for mobilizing public opinion and the needed response from those who have the responsibility of decision in financial matters.

The need for exposition

In broad matters such as those we are here discussing, exposition and communication are of vital importance. The diaries of the late James V. Forrestal, the first Secretary of Defense, who carried tremendous responsibilities during and after World War II, contain the following statement:

"The difficulty of government work is that it not only has to be done well, but the public has to be convinced that it is being done well. In other words, there is a necessity both for competence and exposition, and I hold it is extremely difficult to combine the two in the same person."

This observation is equally valid in other fields involving the public interest. Obviously, in any important matter involving democratic action and an appeal to group response, the heart of the problem is the effective presentation of the issues. They must be presented in the form of a constructive challenge which will develop a broad awakening and response from within the profession, as well as from the public and from our national and industrial leadership. This will involve tremendous effort and ingenuity in the field of publicity, education, and public relations.

Although the problem is sufficiently great to demand emergency action, we must, first of all, be realistic enough to admit that we have in the past, through our own inaction, lost many years of valuable time, perhaps an entire generation.

Efforts to stimulate interest in engineering education must impinge on every member of our profession. You can start right now. Every member owes a debt to his profession and this debt can, in part, be paid off by first coming to grips with the problems in engineering education, and by taking a sustained personal interest in the preparation of the next generation of our profession.

What facts are needed?

1. What kind of graduates does our profession want? What kind should it want?

2. What should be the content of the curriculum, and how long should a course in professional engineering be?

3. What should be the goals of a college of engineering, what degree should be granted, and what professional status should be accorded at that time?

4. Should we have five or six graduate schools of professional engineering located strategically in various parts of the country?

5. How can we make a fair distinction between the mass production of technicians and the personalized development of professional men?

6. What should be the prerequisites of basic education and early training for professional development?

7. What are the capabilities of our engineering colleges today? What are their shortcomings?

8. What are the problems of building and maintaining strong faculties?

9. To what extent should engineering schools (following the practice of medical and foreign engineering schools) employ practicing engineers as clinical professors?

10. What are the problems of university administrators and boards of regents in meeting the demands for expanded engineering colleges?

11. What is the best plan for solving the current and future so-called "shortage" of engineers?

12. What should be done about the issue of professional status vs. unionization of engineers?

13. What are the capabilities of our professional practitioners of today? What are their shortcomings?

14. What are the problems of elevating the status of the profession?

15. What is the public opinion of our profession?

16. Why aren't more engineers in policy-forming political positions?

17. What reorganization is needed to strengthen our professional structure?

18. What measures should be adopted to accelerate desirable changes?

(The report on which this article is based was presented by Mr. Ackerman before the general session on Conditions of Practice at the St. Louis Convention. Vice-President Mason G. Lockwood presided.)

CONCRETE DAMAGE

to 40-year-old Keokuk Dam investigated

Extremely low tailwater in the fall of 1952 provided an opportunity to inspect the downstream piers and spillways of Keokuk Dam, completed in 1913. So much deterioration was noted that it was deemed advisable to make a thorough investigation.

This hydroelectric power development on the Mississippi River at Keokuk, Iowa, was one of the major engineering works of the first half of the twentieth century. Boldly conceived and brilliantly executed by Hugh L. Cooper, M. ASCE, it stands today as a monument to his genius and daring. Construction on the dam was started May 1, 1910, and completed May 31, 1913, a short period of three years for such a tremendous project.

As the structure was built before the days of controlled concrete, no water-cement ratio was specified. None of the concrete was reinforced. Of gravity type, the dam is a composite structure consisting of piers, spillways and arches. There are 119 spillway openings with 120 piers spaced 36 ft on centers. The dam is 42 ft wide at the base and 36 ft $4^1/_8$ in. wide at the top, which is 55 ft above the base. The top of the spillway is 34 ft above the base. Each spillway is equipped with a steel sliding gate 11 ft high. Normal operating head is approximately 34 ft. A cross section of the spillway is shown in Fig. 1.

The concrete design mix was 1:3:5, and 4.6 sacks of cement were used per cubic yard. Sand was obtained from the Des Moines River, about two miles below the dam, where it enters the Mississippi. Stone was obtained from a quarry on the Illinois side of the river, about 300 ft from the dam. Maximum size of aggregate was $4^1/_2$ in. The concrete mixing plant had a capacity of 1,200 cu yd per 10-hour day, and consisted of four drum-type mixers of $1^1/_2$-cu yd capacity each.

Shortly after the Keokuk power plant was put in operation, two weaknesses in the dam and spillway manifested themselves. First, the concrete in the dam gave indications of being vulnerable to the action of weather, and second, spillway discharge produced serious erosion of the limestone river bed adjacent to the toe of the dam. By 1914 it was necessary to anchor the unanchored aprons placed in the latter part of 1913. By 1922 considerable work was required in repairing eroded aprons although a photograph taken December 17, 1922, and reproduced at top right, indicated the downstream pier concrete to be in good condition.

During 1928 and 1929 two sets of railroad tracks resting on wood ties, with sand and rock ballast, were removed from the top of the dam. The moisture trapped in the ballast was leaching through to the under side of the concrete deck arches. One track on the upstream side was replaced using steel ties set in concrete.

In 1934 two of the upstream bullnose piers were replaced because of severe deterioration above the water line. In 1953 two more bullnose piers, in which gage wells were located, were also replaced because of severe weathering and deterioration. Since 1942, gate slot repairs for the upstream steel friction gates has been a continuing maintenance program. In 1950 this repair work was accelerated and was completed in 1954.

Future powerhouse intakes for 11 main units and 2 service units were filled with concrete during 1950–1953. Because of erosion and weathering of the concrete piers, it was deemed expedient from a stability standpoint to fill the openings because of the additional weight thus added to the structure.

In 1950, about 20 in. of the vertical face of the deck arches on both the upstream and downstream sides was removed and replaced on the entire length of the dam. It too was seriously weathered and deteriorated.

Extremely low tailwater conditions which occurred in October 1952 exposed the lower part of the downstream piers. A detailed inspection of these piers was immediately made (on October 16). This inspection revealed that the piers were in an advanced stage of surface disintegration and that severe erosion below the water line had taken place.

In November 1952, a series of downstream soundings were taken which indicated that there had been serious loss of material in parts of the downstream concrete aprons and that the rock key in places was severely eroded.

These findings indicated the necessity for a complete investigation and report on the condition of the dam. For this, the firm of Sverdrup & Parcel, Inc., was engaged in July 1953. The basic objectives of the investigation were to determine the extent of the damage and the nature of the repairs needed, and to check the structural integrity of the dam.

Phases of concrete inspection

First a field survey was made which included a pier by pier inspection. Surface erosion and deterioration were measured by an offset measuring rod which was immediately nicknamed the "gizmo." This survey revealed that all the concrete had deteriorated from its original state. Deterioration was most pronounced in the pier faces adjacent to the spillway ogee that had been intermittently wetted. Aggregate popouts were common in this area. Natural cycles of freezing and thawing had formed measurable cavities on

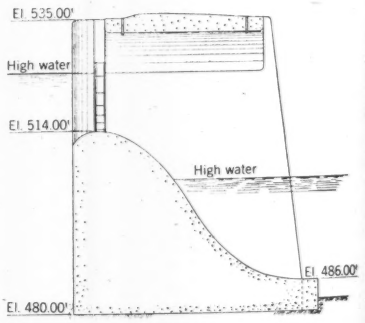
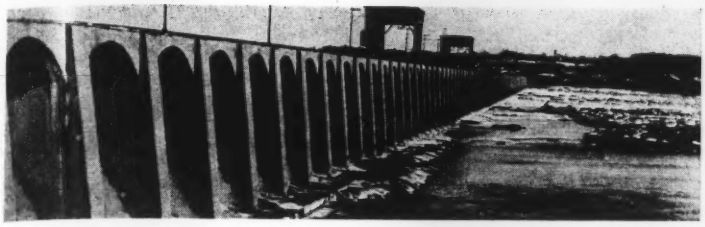


FIG. 1. Keokuk Dam, seen in cross section, consists of 120 piers spaced 36 ft on centers with 119 spillway openings between them. Normal operating head is about 34 ft above base.



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Severdrup & Parcel, Inc., St. Louis, Mo.

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both sides of most of the piers. These cavities were largest in the vicinity of the spillway bucket and extended in some instances halfway up the spillway curve. Of the 120 piers constituting the spillway, all were pitted in the wetted area to various degrees—37 contained major cavities 6 in. or more in depth on each face; 57 contained cavities from 6 to 3 in. in depth; and 26 had minimum spalled areas of 2 in. or less. Two piers had cavities more than 12 in. in depth on the west face and 8 in. deep on the east face.

Most of the piers had cracks on the downstream face which started at the water line and at the spring line of the deck arch, some continuous for the entire height of the pier. This cracking occurred only in areas subjected to wetting and drying and did not extend downward from the water line to the toe of the pier.

The surface of the spillways had roughened and the upper inch had deteriorated from intermittent saturation. Pockets had formed at the joints between construction lifts but were not deep enough to affect the hydraulics or strength of the spillway section.

Through the courtesy of the Portland Cement Association a Soniscope ex-

Most piers had cracks on downstream face extending from water line up to spring line. One of largest cracks was on Pier 78, here shown.

In field survey, piers were inspected by offset measuring rod, nicknamed "gizmo," to determine extent of surface erosion. All concrete was found to be deteriorated. Of the 120 piers, 37 had cavities 6 in. or more in depth on both faces.

amination was made of the concrete in the spillway piers. The Soniscope consists of a pulse generator which is applied to one side of the concrete and which generates sound impulses lasting a few micro seconds at a frequency of about 20,000 cycles per sec. On the other side of the concrete, a pulse receiver picks up the transmitted vibrations. Electronic circuits generate the pulses repetitively about 100 times a second. Experiments have proved that the velocity of propagation of the sound pulse varies with the quality of the concrete. There is a sound theoretical basis for this correlation, the square of the velocity being closely proportional to the modulus of elasticity.

Piers 77 and 78 of the dam and one of the interior powerhouse substructure piers were examined by the Soniscope. Piers 77 and 78 were selected for examination because of the advanced cracking on their downstream faces. Since the powerhouse substructure piers appeared to be in better condition than the outside structures, pulse velocity tests were made on one of them to provide a comparison with the severely exposed spillway concrete.

On Piers 77 and 78, although the sound pulses passed through only 6 ft of concrete, the signals were not clearly received when transmitted through areas constantly wetted by splash. Cracking and deteriorated concrete was indicated in these areas. All pulse velocities below the wetted area were lower than 10,000 fps, indicating poor to questionable concrete (Fig. 2).

Pulse velocities obtained through the concrete in the powerhouse substructure were indicative of good concrete. The received signals were very clear even when the sound path was 22 ft long, and velocities varied from 13,600 to 14,600 fps.

Cores from piers and spillways

Cores were drilled from selected piers and spillways to provide samples for inspection and testing, holes for pressure and dye tests, and for foundation examination. Vertical concrete cores were taken from Piers 27, 77, and 100. On Pier 100, a core of $2^1/_4$-in. diameter was continuously drilled from the top of the deck down to and into bedrock.

Horizontal cores of 6-in. diameter were taken through the full 6-ft width of Piers 37, 38, 77, 78, 98, and 99. A 6-in.-dia core was taken 4 ft 0 in. into the powerhouse substructure pier that had been examined by the Soniscope.

Cores of $2^1/_4$-in. diameter were taken near the bottom of the bucket on Spillways 38, 78, and 99. These were taken primarily to examine the bedding plane of the spillway and to provide for pressure and dye tests.

The concrete cut readily under the action of the diamond drills. A cutting rate of about 1 ft per hour was obtained with a 6-in. diamond drill. The $2^1/_4$-in. diamond drill penetrated about $2^1/_2$ ft per hour, while an 8-in. shot drill cut only about 9 in. per hour. Despite the ease of cutting, only two samples as long as 2 ft were recovered. The longest sound core pieces recovered were 1 ft $1^1/_8$ in. in length. The two cores of 2-ft 0-in. length obtained had cracks that almost severed them.

A large amount of the aggregate cut by the drill contained interior cracks. Cutting the samples with a saw also revealed cracks present in the interior aggregate. To a lesser extent cracks were present in the mortar and at aggregate boundaries. Small voids of $^1/_2$-in. diameter and smaller, showing evidence of lime leaching, were common.

The outer 3 to 6 in. of the cores cut horizontally through eroded areas adjacent to the spillway were heavily weathered and crumbly and contained many laminations and cracks across the core. In the next 6 to 9 in., the laminations were fewer and spaced farther apart. Samples from the interior contained a few vertical cracks. Cracks in the core lined up with cracks in the hole. After drill wash-water had dried, the concrete remained saturated to a depth of 15 to 18 in.

Horizontal cores taken through areas near the fringe of the wetted area were generally of sounder concrete. The surface layer was not crumbly but cracks and laminations were present in the outer 2 to 6 in. Weak planes were observed in the interior, but were less numerous than in the wetted and eroded areas. Visual inspection of these holes after the wash water had dried, indicated no definite surface saturation line.

Cores taken from the powerhouse substructure contained concrete of better quality than those taken from the dam. The samples were longer and the

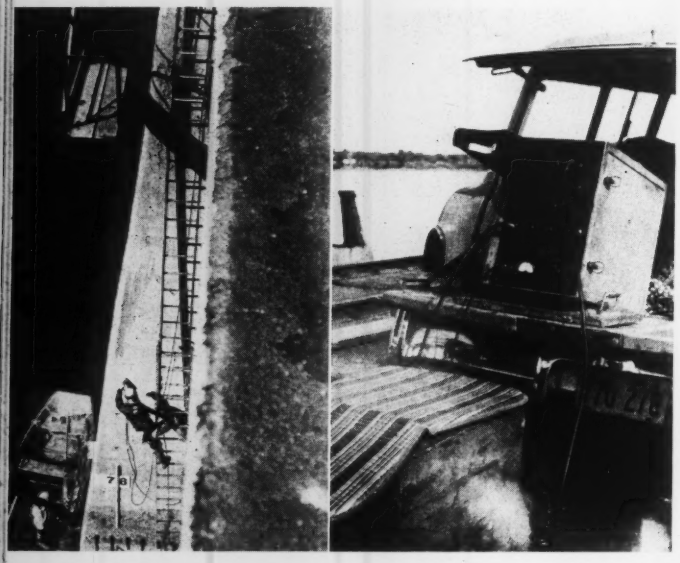


Photo at left shows Soniscope being applied to pier face, while that at right shows equipment for taking readings on top of dam.

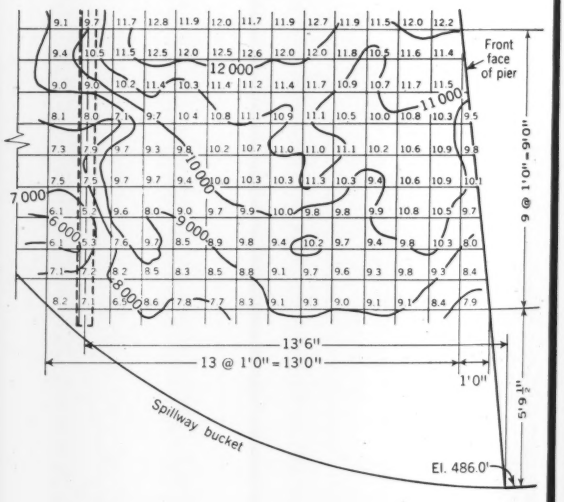


FIG. 2. Soniscope examination of Pier 77 gave these pulse velocity contours, in feet per second. Where velocity is above 15,000 fps, concrete is excellent; 12,000 to 15,000, generally good; 10,000 to 12,000, questionable; 7,000 to 10,000, generally poor; and below 7,000 fps, very poor.

broken ends fitted cleanly together. Voids were not nearly as numerous and cracking in aggregate and along aggregate boundaries was less frequent.

Dye tests on core holes

Dye tests were conducted on the several core holes drilled vertically through the piers and diagonally into the spillway. When the core hole on Pier 100 had been drilled down to the intersection of the spring line of the deck arch, dye was injected under pressure. No seepage of dye was observed at this point. When this same core hole was about one foot above the intersection of the spillway ogee, dye was again injected. This time considerable staining of the concrete, on both sides of the pier, was observed.

A dye test conducted on holes drilled to rock through Spillway 99 showed no trace of dye or bubbling under 70 psi, indicating a good bond between the concrete and the limestone foundation.

In the dye test made at the construction joint at the spring line of the deck arch on Pier 77, seepage was noted on the west side through the joint at a point 7 ft 0 in. north of the battered face. On the east face, seepage began 4 ft 0 in. north of the battered face and extended 3 ft 0 in. further north.

At the core hole in Spillway 78, the most positive evidence of seepage was discovered. When the dye injector was in position, but before any air pressure was applied, it was noticed that pressure was building up in the gage. In a period of about 15 minutes the gage registered a pressure of 5 psi. When 30-psi air pressure had been applied and the air valve closed, the air pressure dropped very rapidly and a few air bubbles were observed in the center of the spillway about 3 ft 0 in. downstream from the toe of the spillway. The air pressure was then increased to 75 psi and the valve left open just enough to maintain this pressure. After a period of several minutes bubbles were observed in the spillway as before, a few at first and then a steady stream, covering a patch of about 14 in. in diameter. A patch of bubbles then appeared in front of Pier 78, then of Pier 77, and then near the center of Spillway 77. Even after the air valve was closed, bubbling continued for several minutes.

At Pier 27 and Spillway 38 no evidence of seepage was observed except on Pier 27, at the spring line of the deck arch, where seepage was observed at a longitudinal crack in the arch. During drilling operations on the deck it was noted that drill wash-water wetted this same area.

Several piers were drilled to determine the depth of cracks on the downstream face. On Pier 99 the face cracks extended 10 in. into the pier. On Pier 78, the cracks were a maximum of 1 ft 4 in. deep. Pier 77 had cracks a maximum of 1 ft $1\frac{1}{2}$ in. deep, and Pier 42 had cracks 10 in. deep. This drilling substantiated conclusions drawn from the Soniscope tests.

Compression tests on horizontal cores through eroded and wetted areas of piers resulted in strengths of 3,320 and 3,603 psi on dry specimens and 2,684 psi on one specimen saturated in water for 48 hours before testing. Two horizontal cores through unwetted areas of piers were tested dry. Compressive strengths were 3,200 and 3,390 psi.

Compression tests on vertical cores through the piers resulted in strengths of from 2,445 to 4,960 psi for dry specimens and from 2,560 to 3,940 psi when saturated.

Three cores from the powerhouse substructure were tested dry, obtaining compressive strengths of 3,665, 4,125, and 4,690 psi.

For freezing and thawing tests, the 6-in. concrete cores were sawed into specimens 2 in. long. One group of specimens was preconditioned by saturation, then quick frozen to 0 deg F and thawed to 70 deg F in water of 70 deg F. A second group was preconditioned in 99-percent humidity at 70 deg F, quick frozen and thawed in air of 99-percent humidity at 70 deg F. A third group of specimens was preconditioned in room atmosphere at 70 deg F, quick frozen and thawed at a room temperature of 70 deg F. The preconditioning of each group was 96 hours.

Specimens in the saturated condition started to show loss of weight at the end of 50 cycles of freezing and thawing. At 90 cycles the average percentage of loss of weight was 35, and at the end of 100 cycles the average loss was approximately 50 percent.

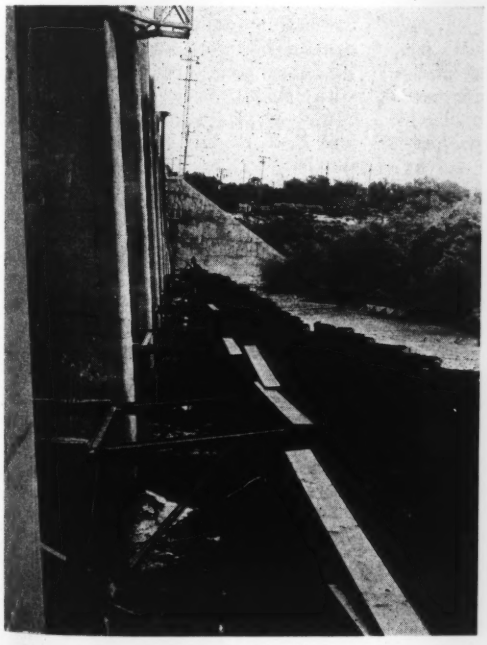
Six samples were tested at the 99-percent humidity condition. They began to deteriorate at the end of 50 cycles, and at the end of 90 cycles the average loss of weight was about 4 percent. At 105 cycles the average loss was approximately 22 percent.

The six samples submitted to freezing and thawing under room humidity conditions showed no visible effects at the end of 130 cycles.

Conclusions on pier concrete

The following conclusions were reached on the condition of the concrete piers:

1. Deterioration is most pronounced through the action of freezing and thawing at the range of tailwater levels and adjacent to the spillway ogee. Penetration of weakened concrete is 12 in. or more in this area.
2. The strength of the concrete is proportional to the amount of alternate wetting and drying it has received, although concrete that is permanently wetted is sound and shows no loss of strength.
3. Concrete that is alternately wet and dry is highly vulnerable to the action of weather, and all exposed con-



Cofferdam for repair of downstream face of Keokuk Dam encloses Spillways 1 to 10. Concrete excavation under way for pier repair, and section of new pier concrete after removal of formwork, are shown in one of photos on front cover.

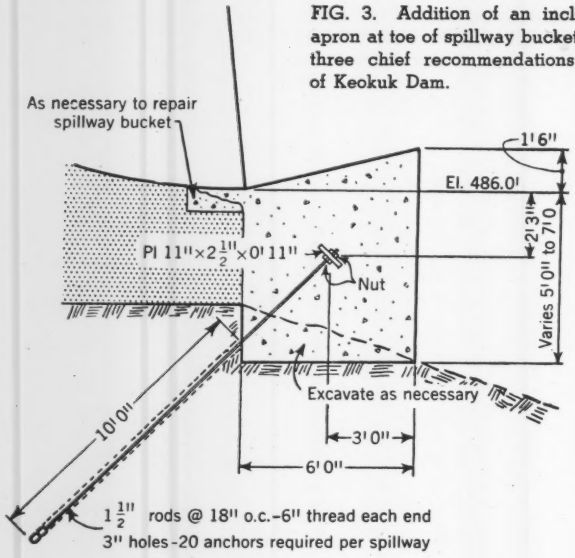


FIG. 3. Addition of an inclined sill or apron at toe of spillway bucket was one of three chief recommendations for repair of Keokuk Dam.

crete is likewise affected to a lesser degree.

As previously stated, the soundings taken in 1952 indicated loss of considerable material from some of the aprons and potentially dangerous erosion of the rock key on a number of them. Cores drilled through the spillways into bedrock in 1953 indicated a good bond of the concrete with the bedding plane. In only one of the four locations tested could it be questioned. As previously mentioned, uplift pressures and downstream air bubbles were encountered during dye injection tests on Pier 78. Because of the good bond with the bedrock of the core sample taken at this location, there is reason to doubt that the seepage is at the bed plane but rather through a seam in the concrete base or the limestone below.

To better understand the action of the discharge jet on the present aprons and to test various remedial devices, a program of hydraulic laboratory model studies was undertaken. The Iowa Institute of Hydraulic Research was engaged to make these studies.

The action of the discharge jet of the model was studied on a sand bed and also on a simulated limestone bed under the operating range of tailwater elevations. A number of aprons and depressed basins, including plain and dentated sills, were tested. From these tests, two important conclusions were reached:

1. For the spillway as originally designed, or with a supplementary horizontal apron, high tailwater conditions must be considered as detrimental as low, since the plunging jet is more pronounced under high tailwater.

2. An inclined sill, either dentated or plain, placed at the toe of the spillway bucket will control the action of the jet so as to place erosive action sufficiently far downstream to minimize the danger of undercutting. With this apron the jet rides beyond the toe for all tailwater conditions. (See Fig. 3.)

Recommendations made

With the results and conclusions obtained from the inspection and testing program, the following repairs were recommended:

1. Removal of deteriorated pier concrete down to sound concrete at the tailwater line and along the ogee curve and its replacement, to the neat line of the piers, with a concrete armor plate having a minimum thickness of 6 in. The deteriorated portion is easily distinguished by the dark stained area above the ogee curve.

2. Waterproofing and sealing of cracks in the bridge deck.

3. New inclined aprons at the end of the spillway buckets on 8 spillways (Fig. 3).

Approval of the management was secured to proceed with the above program, and in the fall of 1954 a contract for the repairs was awarded to Fruin Colnon Contracting Company of St. Louis, Mo. Considerable progress on the construction plant was made last fall by the contractor but high tailwater and cold weather prevented the erection of cofferdams and actual repairs have only recently been started.

In early April of this year the contractor established his construction plant on the Illinois shore and during a period of low river flow drove a sheet-pile cofferdam about 6 ft downstream from the toe of the dam, sealing off nine piers. The deteriorated concrete was easily removed with air hammers. In no case encountered so far has the deteriorated concrete been deeper than the 12 in. anticipated adjacent to the spillway ogee.

The order of procedure for concrete armor replacement is to remove the concrete from the downstream toe of the piers first and pour a tapered column section 6 ft wide, varying from 1 to 2½ ft in thickness, before continuing excavation of the pier faces. At the junction of the old and new concrete, a 2-in. gap is left which is thoroughly cleaned and hand packed with a dry mix after removal of steel forms. This is to provide a watertight joint.

The repair concrete contains 4.8 sacks of cement and 112 lb of fly ash per cu yd, plus an air-entraining agent. The ready-mix trucks are loaded on a flatcar and pushed to location via the railroad tracks on top of the dam in order to protect the waterproofing of the deck. The concrete is placed in the forms by chute. Early test cylinders at 28 days have given results in excess of the specified strength of 3,500 psi. Several cylinders gave a 7-day strength of 2,950 psi.

At this writing (August 1) six piers have been completed, three have been poured, and dry packing is in progress and concrete removal finished and reinforcement placed on Piers 13 and 14. The cofferdam has been relocated to include the second set of nine piers.

For Sverdrup & Parcel Inc., Elmer Schake, A.M. ASCE, Senior Structural Engineer, is in charge of operations, with Ralph Shelton, A.M. ASCE, Structural Engineer for Union Electric, and E. A. Rudulph, A.M. ASCE, Production Mechanical Superintendent for Union Electric, assisting in an advisory capacity.

Acknowledgement is made of the valuable contributions of Dr. Hunter Rouse, M. ASCE, of the Iowa Institute of Hydraulic Research; of the Rock Island District Corps of Engineers; of Paul Mercer, long associated with the Keokuk Plant; of M. W. Johnson, of the Pittsburgh Testing Laboratories; of the Portland Cement Association; and of the operating staff at the Keokuk Plant.

(This article is based on a paper by Messrs. Schake and Shelton presented at the ASCE St Louis Convention, before a Power Division session presided over by G. J. Vencill, a member of the Division's Executive Committee.)

Impact of Modern Business on Engineering Practice—

ADVERTISING

HERBERT C. GEE, M. ASCE

Member, ASCE Committee on Professional Practice;
Gee & Jenson, Inc., Consulting Engineers, West Palm Beach, Fla.

The impact of modern business on engineering practice has been felt by all engineers in private practice and by a great majority of engineers employed in industry. All of us are well aware of the speed-up that has occurred in recent years. This speed-up makes it possible for an individual to work in a much larger territory than was the case a decade ago. One inevitable result has been to emphasize the need for some forms of advertising to assist in keeping a firm's name before prospective clients. This becomes a matter of concern to ASCE and other professional societies because of certain obvious conflicts between conventional advertising and the accepted Code of Ethics.

The Society's Committee on Professional Practice met in Kansas City on April 1 and 2, 1955, with all members in attendance, to discuss two important subjects assigned to it by the Board of Direction. The first, competitive bidding, was discussed by the Committee's chairman, Raymond A. Hill in the August issue (p. 38). The second, advertising by professional engineers, is my subject here.

In the past two or three years, there have come to the attention of the Society a great number of advertisements appearing in periodicals of national circulation and offering professional engineering services. Reprints of full-page spreads have been used as hand bills by certain engineers.

Aims of advertising defined

It will be helpful to examine into the purposes of advertising by engineers. Primarily, an engineer is paying for advertising to assist a prospective client in his effort to locate qualified engineers to undertake a particular professional assignment. It is the opinion of the Committee that the greatest beneficial result which can be hoped for from any ad is that the client will take the trouble to examine the experience record and personal qualifications of the key men in a number of engineering firms.

The desire to advertise professional services varies with the type of engineering firm seeking to obtain new business. The individual in private practice has little occasion to advertise except in a professional directory such as that in CIVIL ENGINEERING. Most firms operate as partnerships or associations of individuals. Depending on the size of the firm, the area in which it practices varies widely.

Certain major corporations offer combined services beginning with financing, preliminary planning, plans and specifications, construction and supervision and, finally, management of major engineering works. These firms handle large projects throughout the world and offer a combined service to a prospective client, usually a major industry or a foreign government. Such firms are constantly seeking new business and have large advertising budgets. The interest of our committee and the Society is centered about their offer of professional engineering services, not their offer of financing, construction and management services. One especially difficult problem will be to obtain the cooperation of such major firms in excluding an offer of professional services from their package deals, about which they advertise so profusely. We may be pleasantly surprised as to their cooperation in this respect, and I sincerely hope this proves to be the case.

The conclusions of the Committee were arrived at after careful study of responses received from the questionnaire it had sent out. These responses indicate clearly that there is a wide diversity of opinion among the members of the profession concerning what constitutes proper advertising of professional engineering services.

Recommended change in Code of Ethics

The Committee recommends that the Code of Ethics, as it pertains to advertising, be amended to read as follows:

"It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:

. . . ."

"7. To use or countenance any paid advertisement, or to use or permit any publicity derogatory to the dignity of the profession."

Advertising was defined as: "Any paid publicity appearing in a publication of general circulation for the purpose of promoting business. Paid advertising shall not be deemed to include listing in a professional directory nor any listing in other directories provided that such listing shall be of the same size and nature as similar listings by other professional engineers likewise listed therein."

The Committee considers it entirely proper that factual statements, with or without illustrations, pertaining to an engineer's professional activities, be made by him or by others for him, such as public relations council, in the public press, radio, television or other media, provided that their tenor is dignified and tends to promote knowledge of the engineer's function in society and to advance the standing of the profession as a whole, without personal aggrandizement.

Finally, the Committee agreed that a dignified brochure descriptive of works completed by an engineer or engineering firm together with experience records of key individuals in the organization is an entirely proper means of informing a prospective client concerning their experience and ability. Such brochures should not be broadcast but should be furnished only to those prospective clients who have a bona fide interest in obtaining professional services of the type offered.

A very important question remains to be answered. Will the profession abide by such rules governing the use of advertising? I do not believe it will be possible to obtain full compliance with this set of ground rules unless the Society and all its members engage in an all-out effort to instill in the individual engineer an appreciation of professionalism in his daily practice which will reflect creditably on the profession as a whole. When each of us is thoroughly convinced that ours is a dignified, learned, and essential profession in modern society, I am convinced that the general quality of our professional conduct will improve.

(This article is based on the paper presented by Mr. Gee at ASCE's St. Louis Convention, before the Conditions of Practice session devoted to the "Impact of Modern Business on Engineering Practice." The session was presided over by Mason G. Lockwood, Vice President, Zone IV.)

HARRY V. SCHNABEL, Jr., J.M. ASCE

Washington Representative, Spencer, White & Prentis, Inc., New York, N.Y.

PILE JACKING

A tricky underpinning job saved considerable time in the construction of a busy underpass in the Nation's capital, permitting vehicles to use the facility much sooner than would otherwise have been possible. The location is the new Kenilworth Avenue underpass, below heavily traveled Benning Road viaduct. The scheme finally adopted was to underpin three massive concrete piers of the existing viaduct, thus avoiding their demolition and reconstruction, and the temporary timber shoring of the span. The J. D. Hedin Construction Company was the general contractor, and the underpinning specialists were Spencer, White & Prentis, Inc., for which the writer is Washington representative.

Original and substitute plans

The original plan called for the installation of nine sets of temporary pile bents and 33-in. beams to shore up the viaduct girders. While the girders were thus supported, the existing concrete piers, with bottoms at El. 30, were to be demolished and reconstructed to an elevation 10 ft deeper, or to El. 20. See Fig. 1. This would allow sufficient space for the new underpass. The reconstructed piers were to have rested on the tops of some 115 concrete-filled piles of 16-in. diameter, each driven to 32-ton capacity.

A substitute plan evolved by Spencer, White & Prentis made it possible, instead, to underpin the existing piers, as also shown in Fig. 1. The reasons that prompted the use of the alternative plan were four fold:

1. Savings in money. The plan enabled the contractor to turn back several thousand dollars to the Department of Highways of the District of Columbia.

2. Shortening of construction time. Underpinning materials were readily available and an immediate start was possible with lightweight, spiral welded pipe and concrete. The fabrication and delivery of the wide-flange shoring beams which would have been needed for temporary support might well have taken six months. In addition, the time-consuming demolition of heavily-reinforced concrete piers was avoided, as well as pile driving, forming, concreting, stripping, etc., for the new piers. All the underpinning was to be completed before the bypass roadway could be opened, and this roadway had to be opened before demolition could begin.

3. Saving in materials. A great amount of timber, caps, bracing, steel, form lumber, and reinforcing steel was eliminated, as well as the excavation and labor in connection with their use.

4. Better safety precautions. The shoring towers originally planned would have had to be in place for at least a year, with traffic passing within a few feet of them all that time. They might be struck at any time by a passing construction vehicle, and they would be continually vulnerable to damage by fire, vandalism, etc.

The proposed plans were given careful scrutiny by engineers of both the District Highway Bridge Division and the Bureau of Public Roads. These engineers investigated all capacities, the step-by-step placing procedure, previous applications of underpinning to other types of work in the past, and finally, the overall effects on all phases of the contract.

Borings showed the following composition of the foundation material, measuring down from El. 34, the ground surface: For the first 10 ft, fill of sand, cinders and other debris; the next 5 ft, brown silty sand; the next 10 ft, grey-brown silty sand and gravel; the next 5 ft, grey clayey silty sand; the next 5 ft, grey silty sand; and, at 35 ft below the surface, greyish brown clayey silty sand.

Underpinning cylinders placed

Placing of the underpinning cylinders followed well-established methods. First an approach pit was dug next to the footing, and a narrow, 6-ft-deep jacking pit was burrowed out beneath the footing. Each of these pits was carefully sheeted with horizontal timbers to prevent loss of ground and to keep soil disturbance to a minimum.

A short piece of pipe, of 12-in. diameter, was then accurately spotted at the center line of the cylinder and driven into the ground, by hydraulically jacking up against the bottom of the concrete pier, until only the top few inches of the pipe was visible above ground. A second section was added to the first, using a special welded sleeve at the joint. This process was repeated until the pipe had been driven to full depth (on this job, 40 ft). Whenever jacking became difficult on the open-end cylinder, hand augers and orange-peel buckets were brought into play to remove the earth from the tube. When final depth was reached, all earth was removed and the pipe immediately concreted. Next day it was pretested to guarantee the cylinder's capacity.

Pretesting also was done by a well-established technique. Two hydraulic jacks were placed between the top of the concreted cylinder and the bottom of the pier and the load gradually increased to 150 percent of the final assigned load, the extra 50-percent overload being a safety factor. On this job, the jacks were run up to 60 tons, since each cylinder had originally been assigned an ultimate 40-ton load.

saves reconstruction of bridge piers

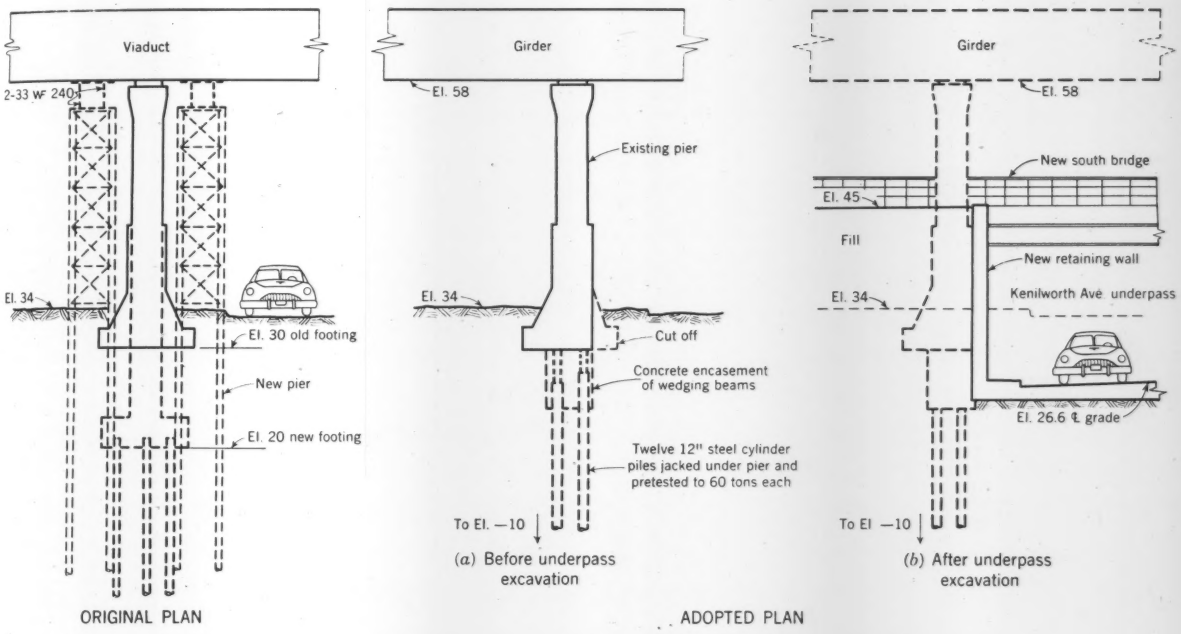


FIG. 1. Alternative method for lowering piers of Benning Viaduct had four advantages. It was less expensive and quicker, required less material, and was safer. In the alternative plan piles were jacked into position against the concrete pier in short sections. Sections were joined by special welded sleeve.

As the cylinder penetrated the ground, the jacks were compensated to keep the pressure constant. When final penetration was reached, and while the jacks still maintained their load, the weight of the pier and structure was transferred directly to the new cylinder by wedging a vertical section of I-beam in between the cylinder and the footing. When this I-beam took over the load, the jacks were of course removed. In this way each of the 34 cylinder piles was driven and tested.

Our engineers have found there is a great difference between underpinning a building, which can run to a tremendous weight, and a bridge, which is comparatively light, and is constantly subject to lateral and reversed loadings. Consequently we used extra care during jacking operations on the viaduct, since there was a possibility that the bridge would be jacked up instead of the cylinder piles being jacked down, especially with the 50-percent overload. Because of the importance of moments in computing these loads, the total tested capacity might be two or three times the calculated vertical load. However, careful and constant checking with transits failed to find any settlement or rising of the piers during or after the underpinning operations.

Underpinning for the Benning Road job was designed by the writer. C. J. Truly was Resident Engineer, and Frederick Thane, Project Engineer. Particular thanks are due to G. I. Sawyer, A.M. ASCE, and to Messrs. Oman, Wilson, and Green of the District of Columbia Highway Department for their assistance in design and overall cooperation.

THE READERS WRITE

Structural steel collar to reduce cost of Lift Slab work

TO THE EDITOR: In his article, "Office Building of 370,000 sq ft Erected by Lift Slab Method," in the June issue, J.P.H. Perry mentions the high cost of the cast-steel lifting collars required. It may be of interest to mention that we have designed and will be using on a future project what we call the Zinn-type collar, made up of structural steel angles (Fig. 1). In Toronto this collar costs approximately half as much as the cast-steel collars, or roughly $14 instead of $28 each.

To check the behavior of our collar, a test was arranged at the University of Toronto, under the direction of W. P. Dumbleton and M. Zinn. During the first loading sequence, from 10 to 100 kips, there was no sign of cracking and the curve of deflections against loads indicated elastic behavior. At 200 kips a crack occurred in the concrete, and at 219.5 kips the increase in deflection was very large for all dials, and equilibrium was obtained when the load was reduced to 216.4 kips. The test piece failed because the concrete failed in punching shear.

The collar was designed for an 8-in. reinforced concrete flat plate on a column grid of 20 ft square. Dead weight on one collar for one slab is in this case 40 kips. With a design load of 170 lb per sq ft, the working load on one slab, per collar, is 68 kips. For lifting two slabs together, the load per collar is 80 kips.

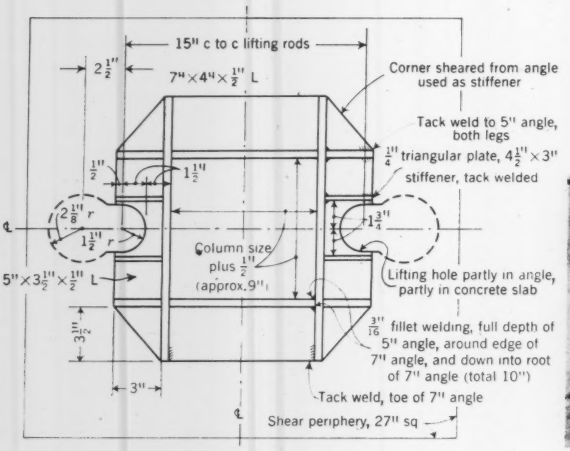
Failure at the 216.4-kip test load was a concrete failure. The structural steel collar was not overstressed. The $\frac{1}{4}$-in. permanent deflection at top of angle legs would not have occurred with the collar fixed in place around the column.

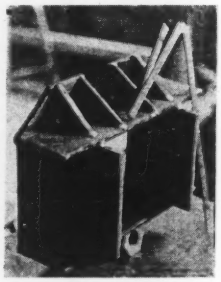
It is concluded that structural-steel collars in general can be used instead of cast-steel collars. Since this collar can represent a saving of approximately 5 cents per sq ft of floor area, it is a matter of importance in the construction industry.

W. SEFTON, A. M. ASCE
W. V. Zinn & Associates Ltd.
Consulting Engineers

Toronto, Canada

FIG. 1. Zinn-type collar is made from standard structural-steel angles with stiffener plates welded in eight locations, two around each lifting hole (one on each side) and other four symmetrically placed at intersections of vertical legs of angles composing collar. These last four stiffeners are thought to be unnecessary.


15" c to c lifting rods
2½"
7"×4"×½" L
Corner sheared from angle used as stiffener
Tack weld to 5" angle, both legs
¼" triangular plate, 4½"×3" stiffener, tack welded
½"
1½"
2⅛" r
1½" r
1¾"
℄
Column size plus 2"
(approx. 9")
5"×3½"×½" L
Lifting hole partly in angle, partly in concrete slab
3½"
3/16" fillet welding, full depth of 5" angle, around edge of 7" angle, and down into root of 7" angle (total 10")
3"
Tack weld, toe of 7" angle
℄
Shear periphery, 27" sq



Could flotation stop settlement of Mexico's Palace?

TO THE EDITOR: According to the article on the settlement of the Palace of Fine Arts in Mexico City, by Messrs. Thornley, Spencer, and Albin (June issue, p. 50), the problem seems to be to make the building settle at the same rate as the surrounding area. Might this be accomplished by inserting a hollow structure beneath the building? If the weight of the building plus the weight of the hollow structure can be made equal to the weight of the soil removed, the compressive stress in the soil beneath the building will equal that in the surrounding area at that depth, and the settlement rate of the building should then equal that of the surrounding area

I believe this method has been employed in new construction where firm bearing was excessively deep, but I do not know whether it has been applied as a corrective measure to an existing structure.

CLIFFORD H. HESELTON, JR., J.M. ASCE
Lockheed Aircraft Corp.
Burbank, Calif.

Flotation method not recommended for Palace

TO THE EDITOR: Perhaps we placed too little stress on the previous history of this settlement in the June article. Many years before city-wide settlement began, and in fact before the Palace of Fine Arts had been completed, serious settlement of the structure was well advanced. The Palace was planned to stand on a fill several feet above the level of the adjacent park and nearby streets. By the time the city-wide settlement began, the structure had already settled 8 ft or more so that it was then in a "bowl" instead of on a "hill." The Mexican authorities were very anxious to have the building jacked up to its original absolute elevation. It was pointed out to them that the cost of such an operation would be altogether out of reason and that if they would merely stabilize the building by underpinning, at its present elevation, the general city-wide settlement would do the trick for them. If the structure stood still while the city settled, the net result—given time and the altogether probable continuance of the city settlement—would be that the building would appear to grow upwards so that in time it would be on the top of a mound as originally intended.

It is true that so long as the building is cutting into the soil on which it immediately rests, the total absolute settlement will be the extent of this cutting plus the city-wide settlement. This local shearing settlement is very slow at present and could possibly be stopped by flotation tanks as suggested by Mr. Heselton.

The flotation method of supporting a structure by removing soil below foundation level and replacing this soil load by the building load has been used extensively for new construction. There are at least a dozen buildings in Mexico City where this method has been used in an attempt to support buildings of medium height and

(*Continued on page 98*)

1955 Annual Convention

New York, N.Y. Statler Hotel October 24–28, 1955

REGISTRATION

Convention Rotunda, Statler Hotel

Opens 9:00 a.m., Monday, October 24, each Convention day 9:00 a.m. to 5:00 p.m.

Registration fee $3.00 (except ladies and students).

ADVANCE INFORMATION ON ATTENDANCE

To assure adequate preparation to make your attendance at the Annual Convention most satisfactory, the Committee requests your assistance. It will be most helpful to have guidance in the number of persons to be expected for the various functions. Will you please use the coupon on page 68, which is to be sent to J. R. Zehner, Convention Chairman.

This does not constitute registration. It will be necessary to register when you arrive at the Convention.

Do not send a check covering all events. The only event for which advance payment is required is the Dinner-Dance on October 26, as detailed in the program.

Your help in furnishing this advance information will measurably facilitate the planning of the Committee.

HOTEL ACCOMMODATIONS

Headquarters of the Annual Convention will be the Hotel Statler, on Seventh Avenue between 32nd and 33rd Streets, directly opposite, and connected to, the Pennsylvania Station. Special arrangements have been made to accommodate many Convention visitors at the headquarters hotel, up to capacity, in the order that reservation requests are received. Send your reservation request early to assure space at the headquarters hotel. For your convenience, a special request form is provided on page 114. Late requests may have to be assigned to other nearby hotels.

ROOMS FOR STUDENTS

The Hospitality Committee of the Metropolitan Student Chapter Conference has reserved a substantial number of double rooms at Sloane House, YMCA, 256 W. 34th St. (two blocks from the Convention hotel), for the use of visiting students during the Convention. The rate is $1.50 per person. Advance reservations are being coordinated by Marshall Jones, Polytechnic Inst. of Brooklyn, Brooklyn, N. Y.

AUTHORS' BREAKFASTS

East Room **Statler Hotel**

8:15 a.m. each morning

Briefing sessions for speakers, discussers and program officials by invitation. Presiding: BARCLAY G. JOHNSON, Vice Chairman, Annual Convention Committee.

KICKOFF PARTY

Monday, Oct. 24

Cocktails, Prizes, and Entertainment

5:30–7:00 p.m. **Penn Top**

First general gathering of the Convention for all members and their wives. Tickets for admission without charge to all registered, courtesy of the Hospitality Committee of the Metropolitan Section

Cafe Rouge Dinner and Dancing

7:30-10:00 p.m. **Cafe Rouge**

An unusual opportunity for an all-ASCE evening in the Statler's famed Cafe Rouge. The Manager has made special reservation for ASCE tables. Tickets available to all who register for the Convention, will waive, until 10:00 p.m., the cover charge for dinner-dancing and entertainment. Dinners are "Dutch treat." When you make your reservation, mention the ASCE Convention. Music by Les Elgart.

MONDAY MORNING

Oct. 24

Construction Division

9:30 a.m. **Ballroom**

Presiding: Charles D. Riddle, Chairman, Executive Committee, Construction Division

Automation in Building Construction

9:30 ROGER CORBETTA, President, Corbetta Construction Co., New York, N. Y.

10:30 DAVID TISHMAN, President, Tishman Construction Co., New York, N. Y.

Engineering Mechanics Division

9:30 a.m. **Keystone Room**

Sponsored by Committees on Experimental Methods and Mechanical Properties

Presiding: Douglas L. McHenry, Chairman, Executive Committee, Engineering Mechanics Division

9:30 **Strain Measurement Errors in Materials of Low Modulus**
R. C. DOVE, Mechanical Eng. Dept., Univ. of New Mexico, Albuquerque, N. Mex.

10:00 **Photoelastic Analysis of Stress in a Gravity Dam**
R. L. SANKS, A.M.ASCE, Asst. Prof., Dept. of Civil Eng., Univ. of Utah, Salt Lake City, Utah.

10:30 **Analogies Using Non-Identical Equations**
R. E. UHRIG, Dept. of Mechanics, U. S. Military Academy, West Point, N. Y.

11:00 **Failure of Plain Concrete Under Combined Stresses**
B. BRESLER, A.M.ASCE, Assoc. Prof., Univ. of Calif., Berkeley, Calif.
KARL S. PISTER, J.M. ASCE, Asst. Prof. of Civil Eng., Univ. of Calif., Berkeley, Calif.

Hydraulics Division

9:30 a.m. — **Ivy Room**

Flood Plain Zoning

Presiding: J. B. Tiffany, Member, Executive Committee, Hydraulics Division

9:30 Flood Plain Zoning to Alleviate Flood Damage

ANTHONY M. LUNETTA, A.M. ASCE, Hydraulic Engineer, Bergen County, Hackensack, N. J.

Discussion

ROBERT L. SMITH, A.M. ASCE, Director, Iowa Natural Resources Council, Des Moines, Iowa

10:00 Need of Flood Plain Zoning to Supplement Flood Control Measures

E. P. SCHULEEN, M. ASCE, Pittsburgh Dist., U. S. Corps of Engineers, Pittsburgh, Pa.

Discussion

ROBERT E. CYPHERS, A.M. ASCE, Supervising Engineer, Div. of Water Policy and Supply, New Jersey Dept. of Conservation and Economic Development, Trenton, N. J.

10:30 Land-Economics Aspects of Flood Plain Zoning

WALTER B. LANGBEIN, A.M. ASCE, Hydraulic Engineer, U. S. Geological Survey, Washington, D. C.

Discussion

H. ALDEN FOSTER, M. ASCE, Parsons, Brinckerhoff, Hall & Macdonald, New York, N. Y.

11:00 Applications of Zoning Principles and Laws to Flood Plain Zoning

HUGH POMEROY, Director, Dept. of Planning, Westchester County, N. Y.

Sanitary Engineering Division

9:30 a.m. — **West Room**

Design and Research

Presiding: Blucher A. Poole, Member, Executive Committee, Sanitary Engineering Div.; Nelson L. Nemerow, Chairman, Committee on Sanitary Engineering Research, Sanitary Engineering Div.

9:30 Submarine Ocean Outfalls for Sewage Disposal

ERMAN A. PEARSON, A.M. ASCE, Assoc. Prof., Sanitary Eng., Univ. of Calif., Berkeley, Calif.

GERALD T. ORLOB, J.M. ASCE, Asst. Prof., Dept. of Civil Eng., Univ. of Calif., Berkeley, Calif.

VINTON W. BACON, M. ASCE, Executive Officer, State Div. of Water Pollution Control, Sacramento, Calif.

10:15 The Mechanism of Reaeration in Natural Streams

DONALD J. O'CONNOR, J.M. ASCE, Prof., Dept. of Civil Eng., Manhattan College, New York, N. Y.

WILLIAM E. DOBBINS, A.M. ASCE, Assoc. Prof., Sanitary Eng., New York Univ., New York, N. Y.

11:00 A New Approach to Trickling Filter Design

WILLIAM T. INGRAM, M. ASCE, Adjunct Prof., New York Univ., New York, N. Y.

Surveying and Mapping

9:30 a.m. — **East Room**

Presiding: R. H. Lyddan, Chairman, Executive Committee, Surveying and Mapping Div.

9:30 The Electronic Distance Meter

E. F. GIGAS, Berlin, Germany.

10:00 Surveys and Maps for the Air Force Academy

EDWARD A. MERRILL, M. ASCE, Assoc. Partner, Skidmore, Owings & Merrill, Colorado Springs, Colo.

10:30 Surveying in the Arctic

S. S. COOKE-YARBOROUGH, A.M. ASCE, Engineer, Tippetts-Abbett-McCarthy-Stratton, New York, N. Y.

11:00 Horizon Sweep

ROBERT H. LYDDAN, A.M. ASCE, U. S. Geological Survey, Washington, D. C.

PROFESSIONAL COOPERATION LUNCHEON

Monday, Oct. 24

12:30 p.m. — **Georgian Room**

Sponsored by Committee on Conditions of Practice

Speaker: CARLTON S. PROCTOR, Past President, ASCE.

Subject: EJC—National and Regional Unity in the Engineering Profession.

Toastmaster: MASON G. LOCKWOOD, Chairman, Committee on Conditions of Practice; Vice President, ASCE.

Officers and members of all EJC Societies are cordially invited to attend this luncheon, sharing the topic of timely concern to the profession.

Per plate, $4.00. Tickets for this event should be purchased before 10:00 a.m. on Monday.

MONDAY AFTERNOON

OCT. 24

Conditions of Practice Session

2:30 p.m. — **Georgian Room**

Is Engineering Registration a Professional Asset?

Presiding: Mason G. Lockwood, Zone IV, Vice President, ASCE

2:00 Eastern Experience

NEWELL L. NUSSBAUMER, A.M. ASCE, Consulting Engineer, Nussbaumer & Clarke, Buffalo, N. Y.; former Member, N. Y. State Board of Eng. Registration.

2:20 Western Experience

STEPHENSON B. BARNES, M. ASCE, Consulting Structural Engr., Los Angeles, Calif.; Member, Calif. Board of Registration for Civil and Professional Engrs.

2:40 General discussion (using speakers as a panel)

Engineering Education—How Much Science and How Much Technology

3:00 The ASEE Evaluates Engineering Education

L. E. GRINTER, M.ASCE, Dean of Graduate School and Director of Research, Univ. of Florida, Gainesville, Fla.; Chairman, Amer. Society of Engineering Education, Committee on Evaluation of Eng. Education.

3:30 Discussion

HARRY S. ROGERS, M.ASCE, President, Polytechnic Inst. of Brooklyn, Brooklyn, N. Y.

3:45 Training Civil Engineers for Civil Engineering

B. A. WHISLER, M.ASCE, Head, Dept. of Civ. Eng., Pennsylvania State Univ., State College, Pa.

4:10 General discussion (using speakers as a panel)

Engineering Mechanics Division

2:30 p.m. — **Keystone Room**

Sponsored by Fluid Dynamics Committee

Presiding: John F. Ripken, Chairman, Committee on Fluid Dynamics, Engineering Mechanics Div.

2:30 Shear Transmission from a Turbulent Flow to Its Viscous Boundary Sublayer

HANS A. EINSTEIN, M. ASCE, Assoc. Prof., Dept. of Mechanical Eng., Univ. of Calif., Berkeley, Calif.

HUON LI

3:15 **A Study of The Causes of Wind-Induced Vibrations in Aerial Cables**

J. SHEA, Bell Telephone Labs. Whippany Lab., Whippany, N. J.

4:00 **Boundary Layer Development at an Open Channel Inlet**

JACQUES W. DELLEUR, J.M.ASCE, Instr. in Civil Eng., Columbia Univ., New York, N. Y.

Construction Division

2:30 p.m. **Ballroom**

Presiding: Charles D. Riddle, Chairman, Executive Committee, Construction Div.

2:30 **St. Lawrence Seaway**

ARVE S. WIKSTROM, A.M.ASCE, Consulting Engineer, Skaneateles, N. Y.

Sanitary Engineering Division

2:30 p.m. **West Room**

Atmospheric Pollution

Presiding: Roy J. Morton, Vice Chairman, Executive Committee, Sanitary Engineering Div.; Paul W. Purdom, Chief, Div. of Environmental Sanitation, Dept. of Public Health, Philadelphia, Pa.

2:30 **The U.S.P.H.S. Research Program in Air Pollution**

ARTHUR STERN, Chief, Air Pollution Control Activities, Robert A. Taft Sanitary Eng. Center, U. S. Public Health Service, Cincinnati, Ohio.

3:00 **Experience with the New Washington, D. C., Incinerator**

WILLIAM A. XANTEN, M. ASCE, Supt., Div. of Sanitation, Eng. Dept., Washington, D. C.

3:30 **Assessment and Control of Radiological Environmental Contaminants**

JAMES G. TERRILL, Chief, Radiological Health Branch, Div. of Sanitary Eng. Services, U. S. Public Health Service, Washington, D. C.

4:00 **Sanitary Engineering Incomes**

JOHN C. BUMSTEAD, M.ASCE, Consulting Engineer, Alfred LeFeber & Assocs., Cincinnati, Ohio.

ARTHUR D. CASTER, M.ASCE, Principal Engineer in charge of Sewage Disposal Program, City of Cincinnati, Cincinnati, Ohio.

Waterways Division

2:30 p.m. **East Room**

Panel Discussion: Bridge Clearances

Presiding: Clarence C. Burger, Chairman, Executive Committee, Waterways Div.

Moderator: Lacey V. B. Murrow, M.ASCE, Brig. Gen., U. S. Air Force, Reserve; Transportation Consultants, Inc., Washington, D. C.

2:30 **The Interest of Bureau of Public Roads in Navigational Clearance Requirements for Highway Bridges**

WALTER KURYLO, Administrative Officer, Bureau of Public Roads, Dept. of Commerce, Washington, D. C.

3:15 **Need for Realistic Approach to Bridge Clearances over Navigable Inland Waters of U. S.**

WILLIAM E. CLEARY, Executive Vice President, N. Y. Towboat Exchange, Inc., and Harbor Carriers, Port of New York and North Atlantic Repr., Amer. Waterways Operators, Inc.

N. L. CARUTHERS, Asst. to President, Commercial Transport Corp., New Orleans, La.

4:00 **The Navigational Clearance Problem in Northeastern U. S.**

ERHARD E. DITTBRENNER, Highway Engineer, Div. 1, Bureau of Public Roads, Albany, N. Y.

TUESDAY MORNING

Oct. 25

Air Transport Division

9:30 a.m. **Ivy Room**

Presiding: Terry J. Owens, Member, Executive Committee, Air Transport Div.

9:30 **Report of Committee on Design of Overlay Pavements**

ROBERT HORONJEFF, A.M. ASCE, Lecturer in Transportation Eng. and Research Engineer, Inst. of Transportation and Traffic Eng., Univ. of Calif., Berkeley, Calif.

10:30 **N. Y. International Airport—Airplane and Passenger Terminal**

JOHN M. KYLE, JR., M. ASCE, Chief Engineer, Port of New York Authority, New York, N. Y.

Engineering Mechanics

9:30 a.m. **Keystone Room**

Sponsored by Committee on Elasticity

Presiding: George Winter, Chairman, Committee on Elasticity, Engineering Mechanics Div.

9:30 **Analytical Studies of Action of Thin Flexible Surfaces Under Load over Flexible Subgrades**

E. REISSNER, Dept. of Mathematics, Mass. Inst. of Technology, Cambridge, Mass.

10:00 **Grillage Beams on Elastic Foundation**

B. DRAPKIN, Flushing, N. Y.

10:30 **On Some Problems in Bending of Thick Rectangular Plates**

D. FREDERICK, J.M.ASCE, Instructor, Applied Mechanics Dept., Virginia Poly. Inst., Blacksburg, Va.

11:00 **Stresses in Cylindrical Pressure Vessels Supported by Elastic Foundations**

W. A. BOOTHE; R. T. GRAY; G. HORVY, Design Analysis Unit, Knoll Atomic Power Lab., General Electric Co., Schenectady, N. Y.

Sanitary Engineering Division

9:30 a.m. **West Room**

Water and Sewage Problems in Suburban Areas

Presiding: Richard R. Kennedy, Member, Executive Committee; Dwight F. Metzler Member, Committee on Public Health Activities, both of Sanitary Eng. Divsion.

9:30 **New Jersey's Approach to Control of Water and Sewage Problems in Suburban Areas**

ALFRED H. FLETCHER, Director, Div. of Env. Sanitation, Dept. of Health, Trenton, N. J.

SANITARY ENGINEERING LUNCHEON

Tuesday, Oct. 25

12:30 p.m. **Ballroom**

Sponsored jointly by Sanitary Engineering Div., Metropolitan Section, Sanitary Group, and AIDIS (Inter-American Assoc. of Sanitary Engineers)

Speaker: STANLEY T. OREAR, Research Director, Commerce and Industry Assn. of New York, New York, N. Y.

Subject: Public Planning from the Businessmans' Point of View

Presiding: RALPH E. FUHRMAN, Chairman, Executive Committee. Sanitary Engineering Div.; FRANCIS ELDER, President, U. S. A. Section, Inter-American Assoc. of Sanitary Engineers, New York, N. Y.

For this subject of general concern to all engineers, all members, guests and friends of ASCE are cordially invited to attend.

Tickets for this event must be purchased before 10:00 a.m. on Tuesday. Per plate, $4.00.

10:15 Planning Sewerage Services for Suburban Areas

R. E. LAWRENCE, M. ASCE, Black & Veatch, Kansas City, Mo.

CHARLES R. VELZY, M. ASCE, Nussbaumer, Clarke & Velzy, New York, N. Y.

GEORGE W. REID, A.M. ASCE, Assoc. Prof., School of Civil Eng., Univ. of Oklahoma, Norman, Okla.

11:00 Financing Water and Sewer Extensions in Suburban Areas

HENRY E. RUSSELL, Hawkins, Delafield & Wood, New York, N. Y.

Structural Division

9:30 a.m. **Georgian Room**

Presiding: Maurice N. Quade, Member, Executive Committee, Structural Div.

9:30 Bending Stresses in Edge-Stiffened Domes

MARIO SALVADORI, M. ASCE, Prof., Columbia Univ., New York, N. Y.

10:00 Heavy and Tall Building Problems in Mexico City

LEONARDO ZEEVAERT WIECHERS, A. M. ASCE, Univ. of Mexico, Mexico, D. F., Mexico.

10:30 Hipped-Plate Building Construction—A Symposium

Moderator: GEORGE WINTER, M. ASCE, Prof., Cornell Univ., Ithaca, N. Y.

MILO S. KETCHUM, M. ASCE, Consulting Engineer, Denver, Colo.

JOHN J. DRISKELL, A.M. ASCE, Consulting Engineer, San Gabriel, Calif.

Waterways Division

9:30 a.m. **East Room**

Sponsored by Committee on Coastal Engineering

Presiding: Clarence C. Burger, Chairman, Executive Committee, Waterways Div.

9:30 Model Studies of Wave Refraction

G. C. RALLS, JR., Research Associate, Univ. of Calif., Berkeley, Calif.

10:00 The Design Wave in Shallow Water

R. L. WIEGEL and K. B. BEEBE, Research Associates, Univ. of Calif., Berkeley, Calif.

10:30 Wave Run-up and Overtopping on Shore Structures

THORNDIKE SAVILLE, JR., J.M. ASCE, Asst. Chief, Research Div., U. S. Beach Erosion Board, Washington, D. C.

11:00 Absorption of Wave Energy by Vertical Walls, with Special Reference to Coastal Protection and Harbor Structures

PER BRUUN, Assoc. Research Prof., Univ. of Florida, Gainesville, Fla.

TUESDAY AFTERNOON

OCT. 25

Air Transport Division

2:30 p.m. **Ivy Room**

Presiding: Terry J. Owens, Member, Executive Committee, Air Transport Div.

2:30 The Effect of Airport Distance on Traffic Generation

JAMES C. BUCKLEY, President, James C. Buckley, Inc., New York, N. Y.

3:30 What Is the Story of Aviation Today

JOSEPH D. BLATT, A.M. ASCE, Asst. Administrator, CAA, Washington, D. C.; Member, Executive Committee, Air Transport Division.

Engineering Mechanics and Structural Divisions—Joint Session

2:30 p.m. **Keystone**

Sponsored by the Committee on Elasticity

Presiding: E. C. Hartmann, Member, Executive Committee, Structural Division; H. N. Hill, Member, Executive Committee, Engineering Mechanics Div.

2:30 Lateral Buckling of Eccentrically Loaded I-Columns

MARIO SALVADORI, M. ASCE, Professor, Dept. of Civ. Eng., Columbia Univ., New York, N. Y.

3:00 Unsymmetrical Bending of Beams with and Without Lateral Bracing

LEO ZETLIN, A.M. ASCE, Senior Designer, Ammann & Whitney, New York, N. Y.

GEORGE WINTER, M. ASCE, Professor, Dept. of Structural Engineering, Cornell Univ., Ithaca, N. Y.

3:30 Elasti-Plastic Analysis of Single-Span Beams and Frames

HERBERT A. SAWYER, JR., M. ASCE, Assoc. Prof., Civ. Eng., Univ. of Connecticut, Storrs, Conn.

4:00 Impact Resistance of Reinforced Concrete Beams

F. T. MAVIS, M. ASCE, Prof. and Head, Civ. Eng. Dept., Carnegie Institute of Technology, Pittsburgh, Pa.

M. J. GREAVES, A.M. ASCE, Prof., Civ. Eng. Dept., Utah Agric. College, Logan, Utah.

F. A. RICHARDS, J.M. ASCE, Grad. Student, Carnegie Inst. of Tech., Pittsburgh, Pa.

Sanitary Engineering Division and AIDIS—Joint Session

2:30 p.m. **West Room**

International Aspects of Sanitary Engineering

Presiding: Ralph E. Fuhrman, Chairman, Executive Committee, Sanitary Engineering Div.; Francis Elder, President, U.S.A. Section, Inter-American Assoc. of Sanitary Engineers (AIDIS), New York, N.Y.

2:30 Sanitary Eng. Programs Operated by Foreign Operations Admin. in Africa, Near East and South Asia

VINCENT B. LAMOUREUX, M. ASCE, Asst. Chief, Near East, Africa, Asia Branch, Public Health Div., Foreign Operations Admin., Washington, D. C.

3:15 Water Supply in Arctic Areas

LLOYD K. CLARK, M. ASCE, Partner, Clark & Groff, Salem, Oreg.

AMOS J. ALTER, M. ASCE, Chief Sanitary Engineer, Alaska Dept. of Health, Juneau, Alaska.

4:00 Recovery of Usable Water from Saline Water

DAVID B. SMITH, Prof. of Civil Eng., Univ. of Florida, Gainesville.

Waterways Division

2:30 p.m. **East Room**

Sponsored by Committee on Coastal Engineering

Presiding: Clarence C. Burger, Chairman, Executive Committee, Waterways Div.

2:30 Shallow-Water Wind Waves in Laboratory Channels

GARBIS KEULEGAN, Hydraulic Research Engineer, National Bur. of Standards, Washington, D. C.

3:00 Sand Bypassing System at Rudee Inlet for Nourishment of Virginia Beach

THOMAS J. MCDONALD, Consulting Engineer, Virginia Beach, Va.

MYRON A. STURGEON, M. ASCE, Consulting Engineer, Virginia Beach, Va.

3:30 Alternatives to Stone in Breakwater Construction

REUBEN M. JOHNSON, M. ASCE, Field Engineer, Portland Cement Assn., Los Angeles, Calif.

4:00 Design Problems Involved in Protection from Tsunamis

KENNETH KAPLAN, Research Asso-

ciate, Broadview Research and Development, Arlington, Va.

POWER DIVISION FIELD TRIP

Tuesday, Oct. 25

2:30 p.m.

Buses will leave the 34th St. entrance of the Statler Hotel at 2:30 p.m. sharp, to take those desiring to inspect the Edward F. Barrett Power Plant of the Long Island Lighting Co. in Island Park, Long Island, east of Idlewild Airport. The plant is now in an advanced stage of construction. Initial capacity will be 156,000 kw. The plant will operate at steam pressures of 1,800 psig, 1,000 deg F, the steam to be reheated to 1000 deg F, after passing through a portion of the turbine. The plant will be ready for testing in August 1956.

Features that will be of interest to civil engineers are the relatively difficult foundation conditions, extensive coal-handling facilities, and circulating water system. Preparation of the site is described in *Proceedings* Paper No. 634 by William Welch.

Buses will return to the Statler Hotel at 5:30 p.m.

Price per person, $3.00.

CONSULTANTS' DINNER

Tuesday, Oct. 25

The Waldorf Astoria

Annual Dinner of American Institute of Consulting Engineers

6:45 Cocktails

7:30 Dinner

Presiding: FRANCIS S. FRIEL, M. ASCE, President, American Inst. of Consulting Engineers, New York, N. Y.

Speaker: CHARLES F. KETTERING, Hon. M. ASCE, Director and Research Consultant, General Motors Corp., Detroit, Mich.

Engineers who wish to attend should address inquiries as to tickets to the headquarters of the American Institute of Consulting Engineers, 33 W. 39th St., New York 18, N. Y.

WEDNESDAY MORNING

OCT. 26

Annual Business Meeting of ASCE

10:30 a.m. **Georgian Room**

Presiding: William Roy Glidden, President ASCE

10:30 Annual Reports

By the President

By the Executive Secretary

11:00 Presentation of Awards

Norman Medal to Karl Terzaghi, Hon. M. ASCE, Prof. of Civil Eng., Harvard Univ., Cambridge, Mass.

J. James R. Croes Medal to John S. McNown, M. ASCE, Prof. of Eng. Mech., Univ. of Mich., Ann Arbor, Mich.

James Laurie Prize to Joseph N. Bradley, M. ASCE, Hydraulics Engr., U. S. Bureau of Public Roads, Washington, D. C.

Thomas Fitch Rowland Prize to M. N. Quade, M. ASCE, Partner, Parsons, Brinckerhoff, Hall & Macdonald, New York, N. Y.

Arthur M. Wellington Prize to R. J. Ivy, A.M. ASCE, Bridge Engr., State Div. of Highways, Sacramento, Calif.; T. Y. Lin, M. ASCE, Prof. of Civ. Eng., Univ. of Calif., Berkeley, Calif.; Stewart Mitchell, M. ASCE, Consulting Engr., Sacramento, Calif.; N. C. Raab, M. ASCE, Project Engr., San Francisco Bay Toll Crossings, Berkeley, Calif.; Vernon J. Richey, A.M. ASCE, Senior Bridge Engr., San Francisco Bay Toll Crossings, Berkeley, Calif.; C. F. Scheffey, J.M. ASCE, Dept. of Civil Eng., Univ. of Calif., Berkeley, Calif.

Collingwood Prize for Junior Members to William J. Bauer, J.M. ASCE, Senior Designer, Harza Eng. Co., Chicago, Ill.

J. C. Stevens Award to M. R. Carstens, A.M. ASCE, Assoc. Prof. of Civ. Eng., Georgia Inst. of Tech., Atlanta, Ga., recognizing his part in the discussion of the paper, "Mechanics of Manifold Flow."

Karl Emil Hilgard Prize to J. M. Robertson, M. ASCE, Prof. of Theoretical and Applied Mech., Univ. of Ill., Urbana, Ill.; Donald Ross, Assoc. Prof. of Eng. Research, Penn. State Univ., University Park, Pa.

Rudolph Hering Award to Harvey F. Ludwig, M. ASCE, San. Engr., Dir., USPHS, Washington, D. C.; W. F. Langelier, Prof. of San. Eng., Univ. of Calif., Berkeley, Calif.; Russell G. Ludwig, A.M. ASCE, Consulting Engr., El Monte, Calif.

Leon S. Moisseiff Award to John M. Biggs, A.M. ASCE, Assoc. Prof. of Structural Eng., Mass. Inst. of Tech., Cambridge, Mass.

James W. Rickey Medal to E. S. Harrison, M. ASCE, Asst. Chief Engr., Georgia Power Co., Atlanta, Ga.; C. E. Kindsvater, M. ASCE, Prof. of Civil Eng., Georgia Inst. of Tech., Atlanta, Ga.

Construction Engineering Prize to J. A. Dominy, M. ASCE, Comdr., CEC, USN, Norfolk, Va.; Charles C. Zollman, A.M. ASCE, Chief Engr., Vacuum Concrete, Inc., Philadelphia, Pa.; Henon W. Pearce, President, Pearce & Gresham Co., General Contractors, Decatur, Ala.

ANNUAL MEMBERSHIP LUNCHEON

Wednesday, Oct. 26

12:30 p.m. **Ballroom**

Toastmaster: JOHN R. ZEHNER, Chairman, Annual Convention Committee.

Honorary Membership Awards: by Past President WILLIAM ROY GLIDDEN to:

FRANK A. BANKS, M. ASCE, Consultant to Bureau of Reclamation, Coulee Dam, Wash.

LEO O. COLBERT, M. ASCE, Rear Admiral (Retired), Director, Washington Office, Arctic Inst. of North America, Washington, D. C.

PARK H. MARTIN, M. ASCE, Executive Director, Allegheny Conference on Community Development and Pittsburgh Regional Planning Assoc., Pittsburgh, Pa.

JOHN I. PARCEL, M. ASCE, Vice President, Sverdrup & Parcel, St. Louis, Mo.

All members, their ladies, guests and friends of ASCE are cordially invited to attend this luncheon.

Per plate, $4.25. Tickets must be purchased before 10:00 a.m. on Wednesday.

STUDENT CHAPTER CONFERENCE

Wednesday, Oct. 26

2:30 p.m. **East Room**

Presiding: John C. Totten, Chairman, Metropolitan Student Chapter Conference, Manhattan College, New York, N. Y.

2:30 Introduction of Chapter Representatives

ENOCH R. NEEDLES, President ASCE.

ROBERT H. DODDS, Chairman, Subcommittee on Student Activities, Annual Convention Committee.

3:00 The Quality of Our Educational Program

THORNDIKE SAVILLE, M. ASCE, Dean of Engineering, New York Univ., New York, N. Y.

3:20 Selecting Our First Job

THOMAS J. FRATAR, M. ASCE, Associate Partner, Tippetts, Ab-

bett, McCarthy & Stratton, New York, N. Y.

3:40 The Importance of Registering as a Professional Engineer

T. KEITH LEGARÉ, Executive Secretary, National Council of State Boards of Eng. Examiners, Columbia, S. C.

For special hotel accommodations for students see elsewhere in this program.

WEDNESDAY AFTERNOON

OCT. 26

Engineering Mechanics Division

2:30 p.m. **Keystone Room**

Sponsored by Committee on Plasticity Related to Design

Presiding: Bruce G. Johnston, Chairman, Committee on Plasticity Related to Design, Engineering Mechanics Div.

2:30 A Virtual Displacement Method for Determining Stability of Beam-Columns Above Elastic Limit

ROBERT L. KETTER, J.M. ASCE, Research Asst., Fritz Eng. Lab., Lehigh Univ., Bethlehem, Pa.

3:00 An Approximate Solution for Plastic Behavior of Circular Membranes

N. A. WEIL, J.M. ASCE, Designing Engineer, Development Div., M. W. Kellogg Co., New York, N. Y.

3:30 Shear Deflection of Wide-Flange Steel Beams in the Plastic Range

W. J. HALL, J.M. ASCE, Prof., Dept. of Civil Eng., Univ. of Illinois, Urbana, Ill.

N. M. NEWMARK, M. ASCE, Research Prof., Structural Eng., Univ. of Illinois, Urbana, Ill.

Highway Division

2:30 p.m. **Washington Room**

Highway Engineering Manpower

Presiding: Roy E. Jorgensen, Chairman, Executive Committee, Highway Div.

2:30 Panel presentations by:

CARL E. FRITTS, M. ASCE, Committee Chairman, Vice President in Charge of Eng., Automotive Safety Foundation, Washington, D. C.

HAROLD G. SOURS, A.M. ASCE, Partner, Baldwin & Sours, Columbus, Ohio.

ROBLEY WINFREY, M. ASCE, Highway Engineer, Personnel and Training Office, Bureau of Public Roads, U. S. Dept. of Commerce, Washington, D. C.

DWIGHT H. BRAY, M. ASCE, Director, Maintenance Dept., State Highways, Frankfort, Ky.

HARMER E. DAVIS, A.M. ASCE, Prof., Dept. of Civil Eng.; Director, Inst. of Transportation and Traffic Eng., Univ. of Calif., Berkeley, Calif.

Power Division

2:30 p.m. **Ivy Room**

Presiding: R. A. Sutherland, Vice Chairman, Executive Committee, Power Div.

2:30 Circulating Water System of Trombay Thermal Station

G. E. ARCHIBALD, A.M. ASCE, Engineer, Ebasco Services, Inc., New York, N. Y.

W. WALLACE, M. ASCE, Chief Engineer, Sir Bruce White, Wolfe Barry & Partners, London, England.

3:15 History of Power Cost in New England

H. M. TURNER, Consulting Engineer, Boston, Mass.

4:00 Prefabricated Piping-Film

Furnished by Grinnel Company, New York, N. Y.

Sanitary Engineering Division

2:30 p.m. **West Room**

Design and Research

Presiding: Richard Hazen, Member, Executive Committee, Sanitary Engineering Div.; Charles R. Velzy, M. ASCE, Nussbaumer, Clarke & Velzy, New York, N.Y.

2:30 Lime Reclamation from Water Softening Sludge

FRED KRAUSE, Board of Water and Elec. Light Commissioners, Lansing, Mich.

3:15 Solids Consideration in Dispersed Growth Aeration

NELSON L. NEMEROW, A.M. ASCE, Assoc. Prof., Dept. of Civil Eng., North Carolina State College, Raleigh, N. C.

4:00 Design Factors in Activated Sludge Process

L. S. KRAUS, Chemist, Greater Peoria Sanitary Dist., Peoria, Ill.

Structural Division

2:30 p.m. **Georgian Room**

Presiding: Earnest C. Hartmann, Vice Chairman, Executive Committee, Structural Div.

2:30 Wind Loadings on Tall, Guyed Steel Towers

ROBERT H. SHERLOCK, M. ASCE, Dept. of Civil Eng., Univ. of Mich., Ann Arbor, Mich.

3:15 Design of Tall, Guyed Steel Towers

EDWARD COHEN, J.M. ASCE, Ammann & Whitney, New York, N. Y.

4:00 Construction of Tall, Guyed Steel Towers

R. A. VAUGHAN, Product Manager, Dresser-Ideco Co., Columbus, Ohio

ANNUAL DINNER AND DANCE

Wednesday Evening

6:30 Assembly and cocktails, Rotunda

Cocktails courtesy of Hospitality Committee, Metropolitan Section.

7:30 Dinner, Ballroom

9:00 President's Reception and dancing

Dinner, music, dance music, entertainment.

For this social evening, special arrangements can be made for the reservation of tables seating 10 persons. Members may underwrite complete tables, or pool reservations with others. Orders for tables must be accompanied by check in full and list of guests. Send orders and checks to:

The American Society of Civil Engineers, 33 West 39th St., New York 18, N. Y.

The published seating list will close at 2:00 p.m. Tuesday, October 19. Tickets purchased after that hour will be assigned to tables in order of purchase. Sale of tickets will be limited to capacity of the Ballroom.

Formal dress. Per plate, $10.00.

THURSDAY MORNING

OCT. 27

Highway Division

9:30 a.m. **West Room**

Control of Highway Access

Presiding: Curtis J. Hooper, Member, Program Committee, Highway Div.

9:30 Dividends from the Los Angeles Freeway System

LLOYD ALDRICH, City Engineer, Los Angeles, Calif.

10:00 Control of Highway Access in Indiana

C. E. VOGELGESANG, M. ASCE, Chief Engineer, State Highway Dept. of Indiana, Indianapolis, Ind.

10:30 Economic Effects of Modern Limited-Access Highways Including Property Value Changes near Gulf Freeway

D. C. GREER, M. ASCE, Highway Engineer, State Highway Dept., Austin, Tex.

11:00 Control of Highway Access

B. D. TALLAMY, A.M. ASCE, Chairman, N. Y. State Thruway Authority, Albany, N. Y.

11:30 Analysis of Highway User Benefits for Completing Interstate System in California

RALPH A. MOYER, A.M. ASCE, Prof. of Civil Eng., Inst. of Transportation and Traffic Eng., Univ. of Calif., Berkeley, Calif.

FACULTY ADVISERS CONFERENCE

Thursday, Oct. 27

9:00 a.m. **Dallas Room**

Presiding: C. RUSSELL DOLE and CHARLES E. CLARRIDGE, regional members, Committee on Student Chapters

Faculty Advisers of 50 ASCE Student Chapters in the Middle Atlantic and northeastern areas will convene upon invitation for discussion of Chapter operations.

This all-day conference, while primarily for Faculty Advisers, is open to any and all who may be interested in Society activities in behalf of civil engineering students.

Power Division

9:30 a.m. **East Room**

Presiding: R. A. Sutherland, Vice Chairman, Executive Committee, Power Div.

9:30 The St. Lawrence Power Development

G. R. RICH, M. ASCE, Partner, Chas. T. Main Inc., Boston, Mass.

10:15 Fish Facilities at McNary Dam

L. E. RYDELL, M. ASCE, Chief Engineer, Planning Branch, Corps of Engineers, Walla Walla District, Walla Walla, Wash.

G. H. VON GUNTEN, A.M. ASCE, Civil Engineer, Corps of Engineers, Walla Walla Dist.

HUGH A. SMITH, JR., J.M. ASCE, Walla Walla Dist., Corps of Engineers.

BERTON M. MCLEAN, Walla Walla Dist., Corps of Engineers.

11:00 Interim Report of Committee on Progress in Power Plant Design

GLENN H. VON GUNTEN, A.M. ASCE, Civil Engineer, Corps of Engineers, Walla Walla Dist.

Soil Mechanics and Foundations Division

9:30 a.m. **Georgian Room**

Presiding. Arthur Casagrande, Member, Executive Committee, Soil Mechanics and Foundations Div.

9:30 Origin and Properties of Lagoonal Sediment of Puerto Rico

DON U. DEERE, A.M. ASCE, Assoc. Prof., Dept. of Civil Eng. and Geology, Univ. of Ill., Urbana, Ill.

10:00 The Soil Modulus of Lateral Pile Reaction

BRAMLETTE MCCLELLAND, Principal, McClelland Engineers, Houston, Tex.

JOHN A. FOCHT, JR., A.M. ASCE, Assoc. Engineer, Greer & McClelland Engrs., Houston, Tex.

10:30 California Experience with Horizontal Drains for Landslide Correction and Prevention

TRAVIS W. SMITH, A.M. ASCE, Senior Materials and Research Engr., Calif. Div. of Highways, Sacramento, Calif.

GIFFORD STAFFORD, Calif. Div. of Highways, Sacramento, Calif.

11:00 Grouting with Clay and Soil Cement Grouts

STANLEY JOHNSON, M. ASCE, Assoc. Partner, Moran, Proctor, Mueser & Rutledge, New York, N. Y.

SOIL MECHANICS LUNCHEON

Thursday, Oct. 27

12:30 p.m. **Ballroom**

Sponsored by the Soil Mechanics Division

All members, guests and friends of ASCE are cordially invited to attend and take part in this event devoted to one of the vitally important engineering problems of the day.

Per plate, $4.00. Tickets must be purchased before 10:00 a.m. on Thursday.

THURSDAY AFTERNOON OCT. 27

City Planning Division

2:30 p.m. **West Room**

Industrial Development in Suburban Communities

Presiding: Fred W. Tuemmler, Vice Chairman, Executive Committee, City Planning Div.

2:30 Industrial Location Factors

JEROME PICKARD, Research Director, Economic Development Committee, Washington Board of Trade, Washington, D. C.

3:00 Organizing the Industrial District

VICTOR ROTERUS, Chief, Area Development Div., Office of Technical Services, U. S. Dept. of Commerce, Washington, D. C.

3:30 Designing the Modern Industrial Plant

EDWARD X. TUTTLE, A.I.A., Vice President, Giffels & Vallet, Inc.; L. ROSSETTI, Assoc. Engrs. and Architects, Detroit, Mich.

4:00 Zoning for Industry

DENNIS O'HARROW, Executive Director, American Society of Planning Officials, Chicago, Ill.

Engineering Mechanics Division

2:30 p.m. **Keystone Room**

Presiding: C. O. Dohrenwend, Member, Executive Committee, Engineering Mechanics Div.

2:30 Special Problems in Dynamic Analysis of Shear Buildings

E. COHEN, J. M. ASCE, Designing Engr., Ammann & Whitney, New York, N. Y.; L. S. LEVY; L. E. SMOLLEN, J.M. ASCE, Senior Vibrations Engr., Sikorsky Aircraft, Bridgeport, Conn.

3:00 Plastic Deformation of a Beam Under Symmetric Impulsive Loading

B. A. COTTER; P. S. SYMONDS Prof., Brown Univ., Providence, R. I.

3:30 Blast-Resistant Building Frames

B. G. JOHNSTON, A.M. ASCE, Gibbs & Hill, Inc., New York, N. Y.

A. MATHEWS, J.M. ASCE, Instructor, Dept. of Civil Eng. and Mechanics, Lehigh Univ., Bethlehem, Pa.

4:00 Dynamic Response of Tall Structures to Lateral Loads

LEO SCHENKER, A.M. ASCE, Member of Technical Staff, Bell Telephone Labs., Inc., Murray Hill, N. J.

Power Division

2:30 p.m. **East Room**

Presiding: R. A. Sutherland, Vice Chairman, Executive Committee, Power Div.

2:30 The Sir Adam Beck Power Plant
OTTO HOLDEN, M. ASCE, Asst. General Manager, Eng., The Hydro-Elec. Power Comm. of Ontario, Toronto, Ont., Canada

3:15 Strengthening a Dam by Post-Tension Cables
S. S. MORRIS, M. ASCE, City Engineer, City Hall, Cape Town, South Africa.

4:00 The Waneta Power Development
A. F. SAMUEL, M. ASCE, Hydraulic Engineer, Stone and Webster Eng. Corp., Boston, Mass.

Soil Mechanics and Foundations Division

2:30 p.m. **Georgian Room**

Presiding: Ralph B. Peck, Member, Executive Committee, Soil Mechanics and Foundations Div.

2:30 Design and Construction Features of an Ore Dock at Hamilton, Ontario
L. H. CHATER, Chief Engineer, The Steel Company of Canada, Hamilton, Ontario.

3:00 Novel Approach to Design of an Ore Dock on Soft Ground
LEO CASAGRANDE, M. ASCE, Consulting Engineer, Cambridge, Mass.

3:30 Field Measurement of Subsurface Ground Movements
STANLEY D. WILSON, A.M. ASCE, Partner, Shannon & Wilson, Seattle, Wash.

4:00 Theory of the Two Layered System, Its Application and Validity
DONALD M. BURMISTER, M. ASCE, Prof., Dept. of Civil Eng., Columbia Univ., New York, N. Y.

4:30 Subsurface Investigation for Universal Atlas Cement Plant, Gary, Ind.
JORJ O. OSTERBERG, A.M. ASCE, Prof., Dept. of Civil Eng., Northwestern Univ., Technological Inst., Evanston, Ill.

Structural, Highway Divisions—Joint Session

2:30 p.m. **Skytop**

Presiding: Robert H. Dodds, Member, Committee on Session Programs, Structural Div.

2:30 Timber Highway Bridges
T. K. MAY, M. ASCE, Director of Technical Service, West Coast Lumbermen's Assoc., Portland, Oreg.

3:00 Experience with Composite Bridge-Deck Construction
C. F. BLANCHARD, M. ASCE, Deputy Chief Engr., State Dept. of Public Works, Albany, N. Y.

Walt Whitman Bridge Across Delaware River

3:30 Design of Main-Bridge Substructure and Philadelphia Approaches
C. W. HANSON, M. ASCE, Partner, Modjeski & Masters, Harrisburg, Pa.

4:00 Design of Main-Bridge Superstructure and New Jersey Approaches
MILTON BRUMER, M. ASCE, Prin. Design Engr., Ammann & Whitney, New York, N. Y.

4:30 Construction of the Project
HOMER R. SEELY, M. ASCE, Project Engr., Modjeski & Masters, Camden, N. J.; Ammann & Whitney, New York, N. Y.

CORNELL DINNER

Thurs., Oct. 27 **5:30 p.m.**

The Cornell Society of Engineers will meet for a social hour, buffet, dinner, and address at the Engineers' Club, 32 West 40th St., New York 18, N. Y. The speaker will be Gordon Fletcher, M. ASCE, Vice President, Raymond Concrete Pile Co., and his subject, "Offshore Radar Stations." The time of this meeting has been arranged to permit attendance at the ASCE Smoker, immediately following. All Cornell engineers and their guests are welcome. For reservations call: William Leonard, Gramercy 3-5600, Ext. 4336.

MEN'S SMOKER AND SHOW

Thursday, Oct. 27

8:00 p.m. **Penn Top**

A well-earned reputation for informality, excellent entertainment, refreshments to a man's liking, and a chance to swap yarns with old friends, has become attached to this ASCE Smoker.

8–9 p.m. Time to start the evening properly
9–10 p.m. The pick of the talent from Broadway and TV
10 p.m. Sandwiches, snacks, beer and coffee with bar service

NOTE: To meet the convenience of those attending college dinners, the show has been timed so that there is no need to miss any of the acts. Also note that the ladies are being entertained elsewhere on this same evening, and won't return till late!!

Per person $3.50

FRIDAY ALL DAY

OCT. 28

City Planning Division Meeting at Princeton University

Sponsored by The Green Foundation School of Engineering, Princeton Univ., and The Urban Land Institute

Morning Session

9:15 a.m., Harvey Firestone Library, Princeton University

Transportation Planning

Presiding: J. Cal Callahan, Member, Executive Committee, City Planning Div.

9:30 Planning a Port—Focal Point of Transportation
ROGER H. GILMAN, M. ASCE, Director of Port Development, Port of New York Authority, New York.

10:15 Planning for an Airport, as a National Transport Facility and Also as a Local Land Use
WILEY POST, JR., Manager of the Allentown-Bethlehem-Easton Airport.

11:00 Planning for Transportation in Cities—Report of National Committee on Urban Transportation
D. GRANT MICKLE, M. ASCE, Director, Traffic Eng. Div., Automotive Safety Foundation, Washington, D. C.

11:45 Prospects for Coordination of Transportation Planning
BURTON W. MARSH, M. ASCE, Director, Traffic Eng. and Safety Dept., Automobile Assoc. of America, Washington, D. C.

12:45 Luncheon
Served cafeteria style at one of the University's student eating halls, 12:45 p.m. to 2:00 p.m.

Afternoon Session

2:30–5:30 p.m., Harvey Firestone Library, Princeton Univ.

Panel Discussion and Open Forum

Presiding: J. Cal Callahan, Member, Executive Committee, City Planning Div.

Moderator: GERALD W. COLLINGS, Manager, Dept. of Transportation and Communication, U. S. Chamber of Commerce.

Panel Members: Messrs. Gilman, Post, Mickle, Marsh.

Those desiring hotel accommoda-

tions in Princeton for Friday evening, Oct. 28, please write to:

J. CAL CALLAHAN, 256 Bushkill St., Easton, Pa.

before September 15, 1955.

Football

PRINCETON vs. BROWN

Sat., Oct. 29

Members wishing to attend the football game on Saturday, please advise prior to Oct. 15, 1955, and tickets will be reserved.

GENERAL CONVENTION EXCURSION

Friday, Oct. 28

Inspection of Brooklyn Navy Yard
At 9:15 a.m. sharp, buses depart from 32nd Street door of Statler Hotel, returning approximately at 2:00 p.m. As guests of the Commander of the New York Naval Shipyard, Rear Admiral Cowdrey, a conducted tour of the Brooklyn Yard will be enjoyed by ASCE members and their families. Among the points of unusual interest are a reconstructed drydock, of latest design, and a new-type super carrier, which is now under construction.

Luncheon will be served in the commissioned officers' mess.

Tickets per person, $3.75, which covers all cost of the inspection tour including the lunch. Tickets must be purchased before 4:00 p.m., Thursday. Sale will be limited to the capacity of the commissioned officers' mess.

President's Post-Convention Inspection Tour of Puerto Rico

Leave New York Friday, Oct. 28, or Saturday, Oct. 29

A most unusual opportunity to inspect Puerto Rico is being offered members of ASCE and their families, in a personally escorted President's Inspection Tour. For five days following the Annual Convention this group will enjoy the warm hospitality of Puerto Rico, with a chance to inspect the impressive and extraordinary construction projects there. The tour, which will be led by the Society's President and his wife, is being arranged to meet the interests of both engineers and their wives. With the enthusiasm of those attending the 1954 Post-Convention tour in mind, provision has been made for a larger group on this Puerto Rico trip. Yet a limit of 80 persons has been established, out of necessity, with reservations accepted in order of receipt.

For this inspection, the Puerto Rico Section of ASCE, the Puerto Rico Economic Development Administration, and Pan American World Airways are assisting the Annual Convention Committee with arrangements. Adequate time will be allotted for sightseeing, social events, and recreational activities, with plans provided by Puerto Rico Section, airways, and government officials.

Hotel headquarters in San Juan will be the exotic Caribe Hilton on the beach, noted the world around for its excellent and unusual facilities.

Provision has been made also for a few extra days in the Virgin Islands, for those who may wish to take advantage of their close proximity to Puerto Rico. Headquarters in Charlotte Amalie, St. Thomas, will be the Virgin Isles Hotel. A full schedule of the inspection tour follows.

Friday, Oct. 28
Leave New York (Idlewild) Friday night or Saturday morning (optional), by Pan American Douglas Super 6 Clipper non-stop to San Juan.

Saturday, Oct. 29
Welcoming party at the airport. Transfer to the beautiful Caribe Hilton Hotel, the tour headquarters.
Evening: Get-together dance at the Condado Beach Hotel.

Sunday, Oct. 30
Afternoon (late): Caribe Hilton cocktail party and fashion show by Martha Sleeper.

Monday, Oct. 31
Morning: Orientation meeting conducted by Puerto Rico Section, ASCE, and guest speaker from the Puerto Rico Economic Development Board. This will be followed by an inspection tour of facilities in the city, terminating at the new Isla Verde Airport.
Noon: Lunch at airport.
Afternoon: Inspection tour of airport, return to Caribe Hilton Hotel via industrial and housing projects.
Evening: Social evening sponsored by the Puerto Rico Section, ASCE.

Tuesday, Nov. 1
All day: Beach fiesta excursion to Luquillo Beach (with roast on beach).
Evening: Reception, San Juan officials

Wednesday, Nov. 2
Morning: Air or land inspection of engineered facilities.
Afternoon: Air transfer to St. Thomas or return to New York. At Charlotte Amalie, land transfer to the Virgin Isles Hotel.

Thursday, Nov. 3
All day: Free for shopping and relaxing.

Friday, Nov. 4
Morning: Island inspection tour.
Evening: Barbecue dinner at the Virgin Isles Pool.

Saturday, Nov. 5
Transfer to San Juan and connections to New York or Miami.

The full price of the tour per person (when two are traveling together) for this Puerto Rico inspection is $225.00. (For single travelers it is slightly higher.) This special excursion rate includes first-class air transportation, New York to San Juan and return, transfers between the airport in San Juan and the Caribe Hilton Hotel, hotel for four nights, engineering and sightseeing tours, receptions, fashion show, cocktail parties, and an all-day beach fiesta.

For the St. Thomas side trip, the additional price is $63.00 per person (when two are traveling together). Included in this cost are air fare, transportation between the airport and the Virgin Isles Hotel, hotel for three nights, two meals a day, a sightseeing inspection tour, cocktail party, and barbecue.

Air Transportation to Puerto Rico

To transport the ASCE group to San Juan, the Pan American Airways will provide a scheduled flight in a Douglas Super 6 Clipper, the finest in air travel. Meal service aloft is part of the service.

Early Reservations Necessary

To assure inclusion among those who will enjoy this inspection trip, early reservation is essential. Only 80 can be accommodated. Full information and descriptive pamphlets are available on request from:

Mr. Charles Benisch
Pan American World Airways
80 East 42nd Street
New York 17, N. Y.

All details of reservations are to be

handled through that address. A deposit of $50.00 per person is required for reservation.

SESSIONS OF BOARD

The ASCE Board of Direction will be in session at the following times:

Monday, Oct. 24, 9:30 a.m. to 5:00 p.m.

Tuesday, Oct. 25, 9:30 a.m. to 5:00 p.m.

Thursday, Oct. 27, 2:30 p.m.

INFORMATION AND REGISTRATION

Information and registration facilities will be maintained in the Rotunda on the Convention floor of the Hotel Statler throughout the days of the Convention. Mail and messages will be held for members at the Information Desk.

Advance Information on Attendance at ASCE Annual Convention

This is not an advance ticket order.

Do not send payment. No name needed.

To:

MR. JOHN R. ZEHNER,
General Chairman,

Annual Convention Committee, ASCE
33 W. 39th St., New York 18, N. Y.

It is my plan to attend the Annual Convention. I shall have .... guests attending with me.

During the Convention I plan to attend the following events, tickets for which I shall purchase when I arrive and register:

Function	No. of Tickets
Monday, Oct. 24	
Professional Cooperation Luncheon	
Kickoff Party	
Tuesday, Oct. 25	
Sanitary Engineering Luncheon	
Wednesday, Oct. 26	
Awards Luncheon	
Dinner-Dance	
Thursday, Oct. 27	
Soil Mechanics Lunch	
Smoker	
Friday, Oct. 28	
General Convention Excursion	

LADIES PROGRAM

An attractive variety of events has been scheduled for the entertainment of the ladies attending the Convention. Breakfast and coffee hour are planned for each morning. A list of "Do it Yourself" trips with directions will be posted in the Ladies Hospitality Room where tickets for radio and television studios will also be available.

Monday, Oct. 24

The morning show at Radio City Music Hall will be followed by guided tours to a choice of museums or the United Nations.

Tuesday, Oct. 25

Buses will leave the hotel at 9:30 a.m. for Tarrytown for a visit to the Rockefeller Restoration of Philipse Castle (1683). Luncheon will be served at Tappan Hill overlooking the Hudson River.

Wednesday, Oct. 26

At 2:45 p.m. groups will leave for a conducted tour aboard the *SS United States*.

Thursday, Oct. 27

Breakfast at 9:00 a.m. in the Charleston Garden Restaurant of B. Altman & Co. will feature a demonstration by their interior decorating department.

A Fashion Show in the Empire Room of the Waldorf-Astoria by one of New York's nationally known designers will follow the 12:30 luncheon at this hotel. $4.50 per person. An opportunity to enjoy new and renewed friendships will be provided at the card party to be held at 8:00 p.m. Thursday evening.

Detailed programs for the ladies will be available with a complete listing of other Convention events of special interest to them.

LADIES HOSPITALITY ROOM

Empire Suite **First Floor**

The Hospitality Room will be the gathering place of all ladies attending the Convention. It will be open from 2:00 to 5:00 p.m. on Sunday, Oct. 23, and 9:00 to 5:00 on each Convention day, Monday through Thursday. Hostesses will be in attendance to arrange tours and special events of interest, and to answer questions about facilities of the Convention and the City of New York.

PRESS ROOM

Sutton Room

For the convenience of the technical press, newspapers and radio, a press room will be open throughout the days of the Convention.

ANNUAL CONVENTION COMMITTEES

John R. Zehner, *General Chairman*
Barclay G. Johnson, *Vice Chairman*
Jewell M. Garrelts, *Past Chairman*
William S. LaLonde, Jr., *Board Contact*
Arthur J. Fox, *Metropolitan Section Contact*
Don P. Reynolds, *Secretary*

Awards Luncheon

Edward J. McGrew, Jr., *Chairman;* Joseph S. Ward, Edward G. Wetzel.

Dinner-Dance

Thomas J. Fratar, *Chairman;* Carl A. Arenander, Elmer K. Timby.

Division Luncheons

Gardner M. Reynolds, *Chairman;* Michael N. Salgo, Elmer K. Timby, Joseph S. Ward.

Excursion

Algert D. Alexis, *Chairman;* Emil A Verpillot, Edward G. Wetzel.

Hotel Arrangements

Barclay G. Johnson

Kick-off Party

Barclay G. Johnson, *Chairman;* Thomas J. Fratar.

Publicity

Michael N. Salgo, *Chairman;* Chairmen of all other committees.

Post-Convention Inspection Tour

Algert D. Alexis, *Chairman;* Don P. Reynolds.

Smoker

Emil A. Verpillot, *Chairman;* Algert D. Alexis, Clinton W. Wixom.

Student Activities

Robert H. Dodds, Jewell M. Garrelts.

Women's Committee

Mrs. John M. Zehner, *Chairman*
Mrs. Barclay G. Johnson, *Vice Chairman*
Mrs. Jewell M. Garrelts, *Past Chairman*

Mrs. Algert D. Alexis, Mrs. Carl A. Arenander, Mrs. Robert H. Dodds, Mrs. Arthur J. Fox, Mrs. Thomas J. Fratar, Mrs. Richard Hazen, Mrs. A. Roger Kelly, Mrs. William S. LaLonde, Jr., Mrs. Harold T. Larsen, Mrs. Robert K. Lockwood, Mrs. John Lowe III, Mrs. Edward J. McGrew, Jr., Mrs. Charles B. Molineaux, Mrs. John F. Molloy, Mrs. Enoch R. Needles, Mrs. Malcolm Pirnie, Jr., Mrs. Carlton S. Proctor, Mrs. Don P. Reynolds, Mrs. Gardner M. Reynolds, Mrs. Michael N. Salgo, Mrs. Elmer K. Timby, Mrs. Charles E. Trout, Mrs. Emil A. Verpillot, Mrs. Joseph S. Ward, Mrs. Edward Wesp, Jr., Mrs. Edward G. Wetzel, Mrs. William H. Wisely, Mrs. Clinton W. Wixom.

SOCIETY NEWS

Four Honorary Members to Be Inducted During Annual Convention Program

The four new Honorary Members of ASCE are eminent in several fields—government service, community development, engineering teaching, and consulting work. This year's recipients of the Society's highest honor are Frank A. Banks, of Coulee Dam, Wash.; Rear Admiral Leo O. Colbert, of Washington, D. C.; Park H. Martin, of Pittsburgh, Pa.; and Ira A. Parcel, of St. Louis, Mo. Presentation of their honorary memberships will be a feature of the Wednesday (October 26) luncheon program during the forthcoming Annual Convention in New York.

Highlights in the careers of the new Honorary Members follow.

Frank A. Banks

Frank A. Banks, newly elected Honorary Member, is known throughout the world as a builder of great dams and for his work in natural resource development. A native of Saco, Me., and civil engineering graduate of the University of Maine, he went West in 1906 to grow up with the recently established U. S. Reclamation Service (now the Bureau of Reclamation).

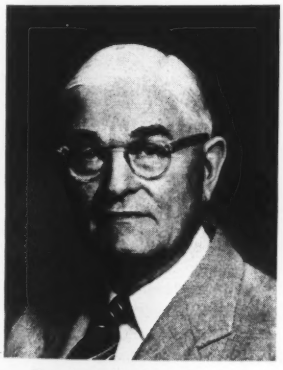
In the Bureau Mr. Banks rose from the position of costkeeper and rodman to become construction engineer and district manager in full charge of construction and development of the great Columbia Basin Project, which among other things involved construction of Grand Coulee Dam and power plants. It was in 1909 that Mr. Banks received the first of many assignments on this project when he became design engineer at Boise, Idaho, on the preparation of designs for Arrowrock Dam. From 1913 to 1916 he was construction engineer in charge of the construction of Jackson Lake Dam in Wyoming; from 1916 to 1926 construction engineer on the Minidoka Project and American Falls Dam, Idaho; and from 1926 to 1933 construction engineer in charge of building the Owyhee Dam and Irrigation Project in eastern Oregon.

As construction and supervising engineer and project manager for the Bureau from 1933 to 1950, Mr. Banks was in charge of the construction of four large earth dams and all irrigation facilities built during the period in addition to Grand Coulee Dam. On leave of absence from the Columbia Basin Project, he served as acting administrator of the Bonneville Power Administration in 1939, and was regional director for the Bureau of Reclamation in the entire Pacific Northwest from 1943 to 1945.

Since Mr. Banks' voluntary retirement from the administrative responsibility of the project in 1950, he has served the Bureau as consultant. He has also been consulting engineer to the Province of British Columbia on the construction of Kenny Dam and to the Government of India on the construction of Bhakra Dam in Punjab. He is one of the two American members of the International Columbia River Engineering Committee for the development of the water resources of the Columbia Basin where Canada is concerned; chairman of the Water Management Subcommittee of the Columbia Basin Interagency Committee coordinating the operation of federal reservoirs in the Columbia Basin for irrigation, flood control, power, navigation, etc.; and United States representative and chairman of the Columbia Interstate Compact Commission engaged in the drafting of a compact among the seven Northwestern states for the development and utilization of the water resources of the Columbia Basin.

In 1940 Mr. Banks' alma mater honored him with the degree of doctor of engineering, and in 1944 Washington State College gave him the honorary degree of doctor of laws. He has served as U. S. member of the International Committee on High Dams, and as a member of the Columbia Basin Advisory Committee. He has been an Associate Member of ASCE since 1915.

At the formal dedication of Grand Coulee Dam on May 11, 1950, the President of the United States presented Mr. Banks with the Distinguished Service Award, highest honor of the United States Department of Interior. The citation read: "While little the Department of the Interior does can add to or detract from the autobiography that Franks Banks wrote in steel and concrete and dams across the valley of the Columbia, which will aid the nation as long as water runs downhill, this citation is tendered in recognition of his service to all the people."



Frank A. Banks, Hon. M.

Leo Otis Colbert

New Honorary Member Leo O. Colbert has devoted his entire professional career to the U. S. Coast and Geodetic Survey, from which he retired recently with the rank of rear admiral. He was director for twelve years, and under his management the Survey made some of its most important achievements. He directed with imagination and energy its

L. O. Colbert, Hon. M.

greatly expanded wartime program and the important planning that preceded hostilities. Projects initiated under his direction, at the specific request of the armed forces and other war agencies, involved all branches of the Survey.

Born in Cambridge, Mass., he received his early education in the Boston public schools. In 1907 he graduated in civil engineering from Tufts College, which years later awarded him the honorary degree of doctor of science.

Admiral Colbert's work has included field assignments as navigator, executive officer, and commanding officer of the various Survey ships operating in the coastal waters of the United States, Alaska, and the Philippines. One of his first assignments was on wire-drag work to locate submerged rocks off the Atlantic Coast, and he later made use of the method in Alaskan coastal waters. During the first World War he was transferred to duty under the Navy Department serving as lieutenant commander on a troop transport that made nine transatlantic voyages through the submarine zone.

From 1928 to 1930 Admiral Colbert was director of coast surveys of the Philippines. In the early thirties he commanded a ship engaged in a comprehensive hydrographic survey of Georges Bank off the Massachusetts coast. This survey, which required the most advanced techniques, brought to light for the first time the highly dissected submarine topography of the northeast Continental Shelf.

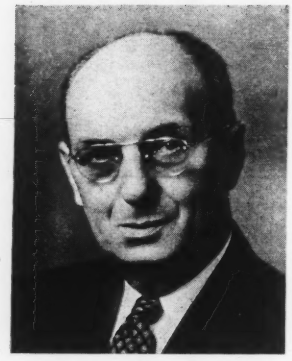
Important advances in aviation charting were also made during Admiral Colbert's administration as chief of the Division of Charts. A series of eighty-seven aviation charts was completed, and other specialized series for long-distance flying were initiated. These charts are now regarded as the most accurate in the country and serve many navigation purposes in addition to their usefulness in the piloting of airplanes.

Admiral Colbert has been a member of the Mississippi River Commission and the advisory council of the Princeton University Department of Civil Engineering, and a trustee of the Woods Hole Oceanographic Institute. He has also been a member of the Arctic Institute of North America, and since his retirement has been serving as director of its Washington office.

A member of ASCE since 1920, he has been active in Society and Section (the District of Columbia) work.

Park H. Martin

Many of the projects that make Pittsburgh the great city it is are directly attributable to the planning and executive genius of new Honorary Member



Park H. Martin, Hon. M.

Park H. Martin. For the past ten years Mr. Martin has been executive director of the Allegheny Conference on Community Development—a private, nonprofit citizens' organization composed of leading industrialists, businessmen and public officials, which has spearheaded Pittsburgh's Renaissance.

A native Pittsburgher, Mr. Martin was educated in the local elementary and high schools. He studied civil engineering at Carnegie Institute of Technology and is one of the very few to have received the honorary degree of doctor of engineering from that institute (it was conferred in 1949).

For more than twenty years Mr. Martin was engaged in the private practice of engineering in Pittsburgh. In 1933 he became chief engineer and assistant director of the Allegheny County Department of Public Works. Later he was made director of the Allegheny County Planning Department, and in that capacity formulated a long-range public works program for the county. While director he was largely responsible for the planning, design, and development of such major projects in the Pittsburgh Improvement Program as the Penn-Lincoln Parkway (a limited-access highway being built by the State Highway Department to carry Routes 22 and 30 through the city), the new $33,000,000 Greater Pittsburgh Airport, and many other improvements.

During Mr. Martin's leadership and direction, the Allegheny Conference on Community Development has become one of the nation's outstanding citizen organizations in the field of community planning. Earlier this year, in recognition of his ten years of service as executive director, the executive committee of the conference presented Mr. and Mrs. Martin with an all-expense trip to Europe. In the countries visited Mr. Martin studied the rebuilding programs being carried out, the transportation systems, the public works projects, and the various city governments in operation, and wrote a series of articles giving his impressions of conditions for one of the local papers.

Mr. Martin is also executive director of the Pittsburgh Regional Planning Association—a private planning and technical organization closely affiliated with the Allegheny Conference. He serves as chairman of the Technical Advisory Committee of the Public Parking Authority of Pittsburgh and the Pittsburgh Urban Redevelopment Authority. He has been a member of the Pittsburgh City Planning Commission since 1946. In 1952 the Governor of Pennsylvania appointed him chairman of the Metropolitan Study Commission of Allegheny County—a unit established by the state legislature to promote uniform development of the county's 129 municipalities and to encourage them to cooperate in meeting joint problems.

A Member of ASCE since 1941 and past-president of the Pittsburgh Section, Mr. Martin was the first recipient (in 1948) of a civic award created by the Section to recognize "outstanding activities in behalf of the Pittsburgh area."

His many affiliations include the American Society of Planning Officials (of which he is a director), the Urban Land Institute, and the American Planning and Civic Association. He has appeared on many national programs devoted to engineering and planning, including the Society's City Planning Division, and has contributed articles and papers in these fields to numerous publications.

John I. Parcel

John I. Parcel, vice-president of the St. Louis firm, Sverdrup & Parcel and new Honorary Member, has combined a teaching and consulting career with eminently successful results in both. He is a graduate of Westfield College and the University of Illinois. From 1909 to 1936 he was an engineering teacher—for most of the period at the University of Minnesota. He was head of the structural engineering department from 1919 on.

Since 1928 Mr. Parcel has also been in civil engineering partnership with L. J. Sverdrup, M. ASCE, a former pupil at the University of Minnesota. From 1928 until 1936 he remained at the University of Minnesota, spending his summers and one year of leave at the firm's offices in St. Louis. In 1936 he gave up his teaching work to devote his entire time to the firm's activities. In 1946 the firm was incorporated, and since that time Mr. Parcel has been a vice-president and director of Sverdrup & Parcel, Inc.

From 1924 to 1926 Mr. Parcel was consulting engineer on the design of the Minneapolis Auditorium. He served from 1941 to 1947 on the consulting board on redesign of the Tacoma Narrows Bridge, and in 1951 and 1952 was a member of the

consulting board on the proposed Puget Sound Bridge.

While at the University of Minnesota he was co-author, with the late Prof. C. A. Maney, of a widely used engineering text, entitled *Treatise on Statically Indeterminate Stresses*, and of a monograph on *Secondary Stresses in Kenova Bridge*. Currently Mr. Parcel, with Prof. B. B. Moorman, head of the civil engineering department at Syracuse University, is completing a book on the *Theory of Statically Indeterminate Structures*. He has also made numerous contributions to engineering journals.

During his twenty-five years of membership in ASCE Mr. Parcel has rendered outstanding service on Structural Division committees—on Manuals, Applied Mechanics, Design of Structural Members, Highway Bridge Floors, Masonry and Reinforced Concrete, Technical Procedure, Factors of Safety, Leon S. Moisseiff Award, and Publications. He was chairman of the Division's executive committee in 1948, and since 1946 has represented the Division on the Research Council on Riveted and Bolted Structural Joints.

John I. Parcel, Hon. M.

In addition to his activities for ASCE, Mr. Parcel has served on the rules committee of the Award Program on Welded Bridges for Steel Construction and on the Jury of Award for this program.

Technical Division Programs Expanded

The fact that over 600 members of ASCE are now participating in committee work of the Technical Divisions was revealed during the two-day Technical Procedure Conference held in Milwaukee, Wis., August 3 and 4. Delegates to the conference also told of expanding activities in several other areas, including ever-increasing activity at Local Section level; more and larger Division-sponsored conferences; new cooperative activities with other professional groups; and new publication procedures to better serve the membership of the Society. In a keynote talk, President William Roy Glidden called attention to the heavy responsibilities carried by this relatively small percentage of our profession for the technical benefit of the entire group. Fifty delegates and officers participated in the Milwaukee Conference. The June issue (page 67) shows the organization of the Committee on Technical Procedure.

Each of the thirteen Technical Divisions of the Society was represented at the conference by its officers. In addition, the members of the Committees on Division Activities, Research, Publications, and Standards were present, along with the President, Presidential Nominee, Budget Committee chairman and staff personnel of the Society.

Among the subjects to which most detailed attention was given was the research needs of the profession. As expressed to the conference by one of the members of the Research Committee, "there is a pressing need to know about new techniques in many of the areas of civil engineering." Technical Divisions were urged to expand their acceptance of responsibility in describing areas in which knowledge is needed, and encouraging research which will produce answers.

The presiding officer of this conference was Vice-President Enoch R. Needles, who is chairman of the Committee on Division Activities. In addition, he represented the Budget Committee, which studied with the Technical Divisions a new budget request of over $50,000 for the 1955-1956 fiscal year. This increased figure is only one measure of the many new activities being planned by the Division for accomplishment during the coming year.

The conference directed attention to specific agenda items. Discussions of such items were led by officers of the Divisions, and included management of Division committees, integration of Junior Members into the work of the Divisions, preparation for better programs at Conventions and conferences, new services to the members affiliated with the Divisions, participation in preparation of standards and public relations for the Divisions.

Committee on Conditions of Practice Meets

The Society's Committee on Conditions of Practice met in Milwaukee on August 6 and 7, with all members but one in attendance and a full agenda to digest. For the first time, members of the constituent committees who are scheduled to become chairmen for the next year were also present. The four-day session was viewed as the most constructive one yet held by this two-year-old department of Society activity.

Prior to the meeting of the Committee, there were two-day sessions of four committees.

The Committee on Professional Practice gave further study to establishing criteria for ethical procedures in securing engagements for professional engineering services. The Committee on Engineering Education met with ASCE representatives on ECPD and recommended methods for developing more effective relationships between the two organizations.

A study of procedures for further improving the status of Junior Members in the Society consumed a two-day session of the Committee on Junior Members. The chairman and vice-chairman of the Committee on Local Sections participated in the sessions. There was also a meeting (the first) of the newly constituted Task Committee on Voluntary Fund Appropriations. This is the group charged by the Board of Direction with developing methods of expending income from the Voluntary Fund "in behalf of the younger civil engineers."

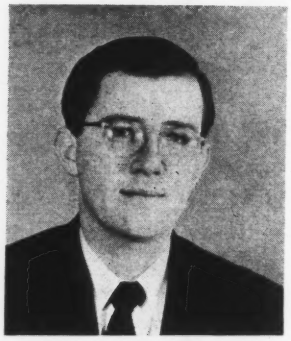
After each constituent committee had outlined its program for the future, the Committee on Conditions of Practice itself considered a number of significant matters, including a compilation of state labor laws and related information to determine their effects on unionization of professional employees. A program was developed for work by the task committee created by the Board of Direction to study and report on conditons affecting federal Civil Service employees.

The Committee also recommended that a new study be made to investigate what the Society properly can do to improve the economic status of its members, bearing in mind its tax status and its relationships to EJC and UET.

Peter L. Monkmeyer Wins J. Waldo Smith Fellowship

Peter L. Monkmeyer, a graduate student in the College of Engineering at Cornell University, has been awarded the J. Waldo Smith Fellowship for 1955–1956. Mr. Monkmeyer received a bachelor degree in agricultural engineering from Cornell in 1952, and is now a candidate for the master's degree in civil engineering. His major field of study is hydraulics. For the past two years he has been in military service—part of the time overseas as draftsman and surveyor in the Corps of Engineers.

Mr. Monkmeyer's research project will involve study of a new type of flow-metering device, the quadrant edge orifice, to determine its usefulness, with the ultimate aim of being able to make a contribution to the problem of flow measurement, in pipes, at low Reynolds numbers.



Peter L. Monkmeyer

The fellowship grant runs for a year and provides $1,000 plus a sum for physical equipment connected with the research.

Committee of Fifteen on E. S. Center Appointed

New developments in the attempt to arrive at a decision as to the location of the Engineering Societies Center Building have arisen since the action taken at the St. Louis meeting of the Board of Direction (July issue, page 75). The separate and differing resolutions concerned with a new building, which had been adopted by the five Societies, were brought to a conference consisting of the five current presidents of the Societies for preparation of an acceptable common wording. The actions recommended to the governing bodies of the five societies have been approved. Our Executive Committee took affirmative action for ASCE at its meeting in Milwaukee early in August.

The recommendations to the governing bodies, which have been approved, are as follows:

"(A) That the majority and minority reports dated April 3 and 4 of the Committee of Five Presidents be received and that this committee now be discharged with thanks.

"(B) That a Special Task Committee of fifteen (15) persons be created by the appointment of three representatives of each Society with all voting in such Task Committee to be by each Society as a unit.

"(C) That the representatives on this Special Task Committee should be:

(*a*) Unbiased.

(*b*) Not an employee of a Society

"(D) That the Special Task Committee be charged with the duty of recommending a specific site for the Engineering Societies Center, based upon a review and comprehensive additional study of feasible locations.

"(E) That the Special Task Committee be empowered to select its own chairman and to employ a Secretary and to engage independent unbiased professional consultants to investigate the problem and to report its findings with recommendation to the Committee.

"(F) That the Special Task Committee report simultaneously to the governing boards of the five societies *as soon as possible* but not later than February 1, 1956.

"(G) That the sum of $15,000 be appropriated by each of the five societies to finance the activities of the Special Task Committee. Any unexpended funds from this appropriation are to revert equally to the Societies.

"(H) That the Societies express their appreciation of the interest and substantial offers of assistance that have been received from various groups.

"*Signed,*
Wm. Roy Glidden, ASCE
H. DeWitt Smith AIME
D. W. R. Morgan ASME
Elgin B. Robertson AIEE
Barnett F. Dodge AIChE"

July 25, 1955

In carrying out the projected selection of a site, ASCE has made the following appointments to the Special Task Committee of Fifteen: Mason Lockwood, Frank Marston, and Ralph Wiley.

World Power Conference Slated for June 1956

United States engineers, scientists, industrialists and government representatives will present 25 papers on the development of atomic energy, steam and gas turbines and related subjects of power and fuel technology at the fifth plenary meeting of the World Power Conference in Vienna, June 17–23, 1956, according to an announcement from Gail A. Hathaway, Past-President of ASCE and chairman of the United States National Committee.

The general theme will be "World Energy Resources in the Light of Recent Technical and Economic Developments." Most of the 45 member nations, including the United States, are expected to participate. U.S. agencies presenting papers will include the Atomic Energy Commission, Bureau of Mines, Bureau of Reclamation, Corps of Engineers, Federal Power Commission and Rural Electrification Administration—all members of the U.S. National Committee.

Austria, host country, is preparing for an attendance of 2,000. The Austrian Government plans to invite all nations with which it has diplomatic relations to be represented at the conference by official delegates. Similar invitations will be extended to inter-governmental and non-governmental international organizations by the Austrian National Committee, which is headed by Franz Holzinger.

Plenary meetings of the World Power Conference are held every six years. Interim sessions, referred to as sectional meetings, are scheduled regionally at two-year intervals.

Unprecedented interest is being shown in the forthcoming full meeting in view of the tremendous advances since the last plenary session in 1950 in the fields in which the Congress is active, and in view of the great possibilities of development ahead. Water, oil, coal and atomic power will be among the topics discussed in the United States contributions to the Vienna program.

Details of this country's participation are being arranged at the headquarters of the U.S. National Committee at 29 West 39th Street, New York City.

District 7 Conference Meets in Milwaukee

Members, officers and delegates from the Local Sections in five states—Michigan, Wisconsin, Minnesota and the Dakotas—gathered at the Hotel Pfister in Milwaukee, August 5 and 6, for the annual District 7 Conference. The attendance of 175 was augmented by members of the Executive Committee of the Board of Direction and of the ASCE Committees on Professional Practice and Technical Procedure, which held their meetings during the same week in the same hotel.

Despite a technical program devoted to irrigation in Pakistan, highways in Wisconsin, and the design of sanitary and storm sewers, plus thoughtful addresses on competitive bidding for professional services on the basis of price, and on the proper advertising of engineering services, lighter affairs were not neglected. After a dinner at the Country Club the baseball fans of the Conference—most of them are fans—watched the Pirates beat the Braves. Field inspection trips were provided to the Hillside Housing Project; to Milwaukee's famous activated-sludge sewage-disposal plant; to the city's water-filtration plant; and to the Oak Creek Electric Power Plant.

Irrigation in Pakistan

R. A. Hill, chairman of the Society's Committee on Professional Practice, who has recently returned from a professional engagement in West Pakistan, explained that Pakistan (East and West Pakistan are on opposite sides of the Indian subcontinent) has a status similar to Canada in the British Commonwealth. At the time of the partition of British India in 1947 the boundaries were drawn from village to village to separate Moslems from Hindus with no regard to the location and purposes of existing irrigation works.

In West Pakistan rainfall is deficient and the normal run of the river inadequate to mature crops. From the Indus River system water is delivered to 30,000,000 acres of land in West Pakistan, on which crops could not otherwise be grown. "This is several times the area irrigated by the Nile" Mr. Hill stated, "and more than the total area irrigated by diversions from all the rivers in the United States." The partition line between West Pakistan and India wanders through this largest irrigation project in the world, placing certain headworks in India for canals built to serve lands in West Pakistan. It is reported that India proposes to take advantage of this situation by diverting Indus River water to a large area in India. "This could cause more than 5,000,000 acres of irrigated land in Pakistan to revert to desert and force the migration of as many million people," Mr. Hill stated. In the solution Pakistan appears to have but one choice—namely, to construct huge dams to conserve the flood waters in the rivers it still controls and to build tremendous canals linking these rivers with those controlled by India. The total cost will be beyond the financial capacity of Pakistan alone. This situation is of concern to the United States.

Bidding on Price Basis

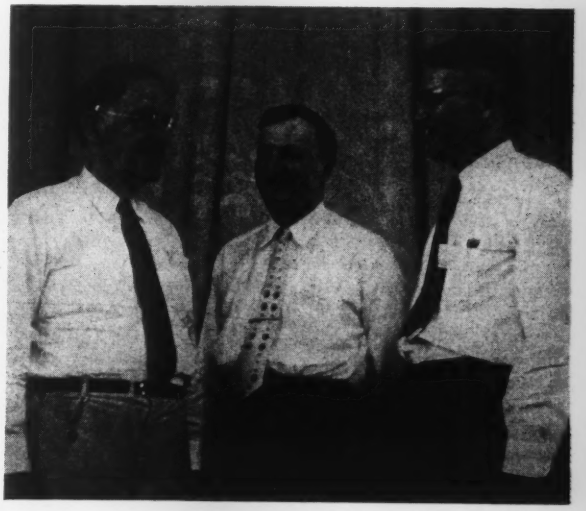
While civil engineering is as old as recorded history, "the consulting engineer as an independent practitioner had no significant place in society prior to the Industrial Revolution," President Glidden told the Conference during a luncheon address. "Whenever an agency of government, industry, or transportation engages in construction or maintenance projects exceeding in size or intricacy those not in ordinary routine it is often more advantageous to engage the service of outside consulting firms than to build up a temporary engineering staff for the purpose."

When the client is in private enterprise the process of engaging a consulting engineer is simple—usually through knowledge of the consultant's professional proficiency and the negotiation of a mutually satisfactory agreement. While this is an ideal arrangement followed to some extent in the more turbulent field of public works, the public administrator must be able to defend his choice particularly when there is a delicate balance of power between the main political parties. Under these circumstances the administrator protects himself from attack by obtaining competitive bids and awarding the professional contract to the lowest bidder.

President Glidden sees no defense for such a course by a public administrator. Not only is it contrary to the ASCE Code of Ethics for a member to participate in such bidding but, more important, the public suffers from it. "It is bad business to award a contract at a figure so low that the engineer cannot do satisfactory work. There may be waste costing several times the amount of the engineer's fee. Cheap engineering is expensive and to employ it is stupid," he concluded.

Proper Advertising

Citing the seventh point in the ASCE Code of Ethics, which requires that we do not advertise "in self laudatory language, or in any other manner derogatory to the dignity of the profession," Francis M. Dawson, ASCE Director for District 16, reminded the Conference that the obligations of the professional engineer to his client are the same whether he works alone, in a team of twenty, or of two hundred. "One does not expect a person who is dedicated to the service of society in a professional manner to advertise as though he were a super-salesman. Self-



Hot but happy, President Roy Glidden confers in Milwaukee with Director Lloyd D. Knapp (center), who is city engineer of Milwaukee, and Ralph P. Larsen (right), chief civil engineer, Milwaukee, Electric Railway and Transport Co. and president of Wisconsin Section, host to District 7 Conference.

praise in advertising is not very convincing." He made the point that the dignity of a professional man—the restraint demanded an any professional judgment—is upset by improper advertising."

"We would be less than realistic if we did not recognize that a modern engineering firm must meet large payrolls in a highly competitive business," Director Dawson admitted, "and the firm must have some way of making itself and its works known by proper advertising." He named as proper small dignified announcements in professional directories enumerating the services the firm has to offer and separately printed limited-edition brochures which are dignified and wholly truthful. He believes the best way to judge an engineer's actions is to consider whether he thought first of the good of the engineering profession. "Good advertising stresses the worth and purpose of all engineering" he concluded.

At a breakfast business meeting of official delegates on the last day of the Conference Prof. J. C. Kohl of the University of Michigan was elected next chairman of the Conference responsive to the wishes of Michigan to be the host to the Conference in 1956.

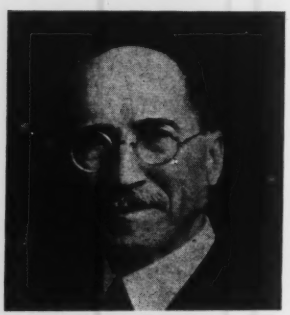
ASCE MEMBERSHIP AS OF AUGUST 9, 1955

Members	9,007
Associate Members	11,601
Junior Members	18,016
Affiliates	71
Honorary Members	42
Total	38,737
(August 9, 1954	37,698)

Society Loses Two Honorary Members

Henry Sylvester Jacoby

Henry Sylvester Jacoby, professor emeritus of bridge engineering at Cornell University and Honorary Member of ASCE, died on August 1 at the age of 98. Professor Jacoby graduated from Lehigh University in 1877 and returned



HENRY S. JACOBY
1857–1955

there to instruct in 1886 after a period of work with the Mississippi River Survey in Memphis, Tenn. Four years later he went to Cornell as assistant professor, remaining there over thirty years. After becoming professor emeritus in 1922, Professor Jacoby moved to Washington, D.C., where he lived until his death.

A distinguished teacher, he worked for many years on problems of engineering education as secretary and later president of the Society for Promotion of Engineering Education (now ASEE), the American Society for Testing Materials, and the American Association for the Advancement of Science. In addition, he was known for his textbooks on bridge engineering, many written with the late Prof. Mansfield Merriman and Dean R. P. Davis. One of his avocations, continued over a period of years, was the study of genealogy with the resultant publication in 1930 of *The Jacoby Family Genealogy*.

Professor Jacoby joined the Society as an Affiliate Member in 1890, becoming Member in 1922 and Honorary Member in 1939.

Charles P. Berkey

Charles Peter Berkey, Honorary Member of ASCE and retired head of the geology department at Columbia University, died at his home at Palisade, N.J., on August 22. He was 88. One of the nation's leading geologists and a pioneer in the application of geology to engineering, Dr. Berkey did the preliminary work that enabled the building of the George Washington and Triborough bridges and the approaches to the Lincoln Tunnel. He was also consultant on the location of Hoover, Grand Coulee, Bonneville, and Norris dams, and on the selection of a site for the United Nations Building. As consulting geologist for the New York Board of Water Supply for many years, he gave advice on the Catskill viaduct project that was credited with saving taxpayers millions of dollars.

Dr. Berkey received a bachelor of science degree from the University of Minnesota in 1892, and then continued his studies there for master's and doctor's degrees. In 1903 he joined the geology department at Columbia, becoming its head in 1914. He was named Newberry Professor of Geology in 1929, and professor emeritus at his retirement in 1939. Dr. Berkey was chief geologist for the American Museum of Natural History's Mongolian expedition in 1922, when dinosaur eggs were found, and for its second Gobi expedition in 1925.

© Bachrach

CHARLES P. BERKEY
1867–1955

Becoming a member of the Society in 1929, Dr. Berkey was elected Honorary Member in 1940. His many affiliations included the Geological Society of America which he served as president in 1941. In 1948 he was recipient of Columbia University's James Furman Kemp Medal "for applying geology to the welfare of mankind."

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

Junior Members of the **Arizona Section** capably handled arrangements for a well-attended Section meeting in Flagstaff on August 13. Following an afternoon business session, Ed Lodge, superintendent of the Saguaro Power Plant of the Arizona Public Service Co., spoke on "Electric Power Supply and Requirements for Arizona," and State Senator Prochnow discussed the annual Indian Pow Wow held in Flagstaff. Other highlights were a trip to the Museum of Northern Arizona and a luncheon, at which slides of some of the state's scenic wonders were shown.

The life of an Army Engineer officer in Bolivia was described at the **Columbia Section's** June meeting in Walla Walla. Maj. Edward C. Bruce, executive officer of the Walla Walla District, discussed some of his experiences while a member of a U.S. Army mission to that country, and showed movies that covered aspects of the daily life.

Warren S. Mann, Georgia Section delegate to the District 10 Council, was featured speaker at the June meeting of the Section's **Central Savannah River Subsection.** His subject—"ASCE in the Growth of the South"—proved very popular. During the business meeting resolutions were passed expressing the Subsection's desire to become a member of the Joint Council of Engineering Societies of the Central Savannah River area.

Members attending the **Illinois Section's** weekly luncheon meetings are sure to hear a good talk. Recent top-flight speakers have included Hallam Tennyson, great-great grandson of the poet and noted author in his own right, who described the Indian outlook on life and the place of India in world affairs from the vantage point of having lived at village level in India. Mr. Tennyson described the way of life as one of dramatic contrast between the ancient and the modern. India's role in world affairs he defined as "one of creative peacemaking." Robert B. Banks, lecturer at Northwestern Technological Institute, outlined recent advances in hydraulic research in Europe, which he finds paralleling our own in most respects. Mr. Banks recently visited thirteen laboratories on the continent and in England.

Congratulations to the **Iowa Section,** which has launched a news sheet this sizzling summer. The first issue, out in August, gives a comprehensive run-down on Society, Section and Student Chapter news. R. E. Kenyon, of the Iowa Highway Commission at Ames, is editor.

New **Ithaca Section** officers are Marvin Bogema, president; A. F. Underhill and N. A. Christensen, vice-presidents; and William O. Lynch, secretary-treasurer.

A lobster cookout at Pemaquid Point, Me., was the high point of the **Maine Section's** fifth anniversary meeting on the afternoon and evening of July 30. An informal field day, with all manner of games, sightseeing trips about the harbor, and fishing occupied the afternoon pleasantly. A large representation of Society officers joined the Section in celebrating completion of an unusually successful first five years.

In October the **Metropolitan Section** will resume activities under the leadership of Richard Hazen, partner in the New York consulting firm of Hazen & Sawyer and a resident of Dobbs Ferry. Officers, in addition to President Hazen, are Roger H. Gilman, Plainfield, N. J., vice-president; Arthur J. Fox, Forest Hills, N.Y., secretary; and William J. Shea, Larchmont, N.Y., treasurer (re-elected).

Richard Hazen

The Vocational Guidance Committee of the **Mid-South Section's Vicksburg Branch** has spearheaded a number of college and vocational guidance drives in the area, in cooperation with local educational and civic groups. It sees, of course, that the engineering viewpoint is well represented on such programs. In addition, the committee arranges tours of the Waterways Experiment Station designed to give aspiring engineers a bird's-eye view of the various types of work carried out. At a recent meeting of the **Little Rock**

Panel discussion of the "Report on San Francisco Bay Salt Water Barriers" brought out members of the San Francisco Section in full force for a meeting on June 21. First view shows (in usual order) Panel Members Charles A. McCullough, Gen. Hans Kramer, S. T. Harding (Moderator), and Walter Schultz. Middle photo shows Kenneth Secor (left), of the University of California—commended as "the student engineer graduate most possessing professional attributes"—with ASCE Past-President Walter L. Huber and Section President Howard C. Wood. Shown, left to right, in right-hand photo are Henry V. Miles and ASCE Directors Larry Elsener and Raymond F. Dawson. General Kramer presented a digest of the report of the State Board of Consultants.

Branch Walter C. Hickmon, head of the Little Rock office of the U.S. Weather Bureau, discussed the advancement of meteorology during his tenure.

New **Syracuse Section** officers are Conrad W. O'Connell, president; Bernard M. Dawson, first vice-president; James E. Clyde, second vice-president; and Walter K. Neubauer, secretary-treasurer. The Section reports a membership of 180 in eight counties, with active participation by about 100 members.

For the third year the **Tennessee Valley Section** devotes the August issue of its ambitious publication, the *Tennessee Valley Engineer*, to its Junior Members. This year Junior Member Donald W. Newton is issue editor. Junior Member problems are discussed in a special article by James M. Cunningham, engineer in TVA's Structural Steel Design Section, who thinks "The biggest reason for lagging interest of Junior Members is responsibility—the unwillingness of the Juniors to accept it and the unsystematic way in which it is delegated to them." Another young engineer—Harold W. Canfield, also in the TVA's Structural Steel Design Section, criticizes his fellow Juniors for "apathy toward the Society's activities" in an interesting article entitled "What Are We Doing for Engineering?"

Shown at June 28 meeting of the West Virginia Section are (in usual order) R. T. Shideler, Leslie C. Gates, featured speaker; Section President J. C. Cobb; Vice-President David R. Agnew; Frank W. Wotiz, secretary-treasurer; former Director George McAlpin; and R. N. Shepard. Mr. Gates discussed coal mining techniques.

Minnesota State Senator Gordon Butler receives a certificate of life membership in ASCE at a recent meeting of the Duluth Section from Executive Secretary William H. Wisely. Shown with them are Section President John Bovee and Mrs. Butler. Senator Butler is a former Director of ASCE and past-president of the Section.

Coming Events

Illinois—Cruise on Lake Michigan to Calumet River and Lake Calumet with inspection of Cal-Sag Canal on the *Mercury*, September 17. Cruise will leave Michigan Avenue bridge at 8:45 A.M. and return at 5:00 P.M. Cost is $6.50 per person including morning coffee and rolls and lunch. Reservations may be made through C. J. McLean, Commonwealth Edison Co., 72 W. Adams St., Chicago, Ill.

Kentucky—Section will be host to District 9 Council meeting at the Campbell House in Lexington, Ky., September 23. Presidential nominee, Enoch R. Needles, will be speaker. Annual joint meeting of the Kentucky and Indiana Sections will be at Spring Mill State Park near Mitchell, Ind., October 1 and 2. Executive Secretary William H. Wisely will speak.

Mid-South—Annual fall meeting at the Claridge Hotel, Memphis, Tenn., October 20–22.

Northeastern—Luncheon with short talk at the Boston City Club, 14 Court Square, September 21 at 12 noon. Reservations must be made the day before (price $1.25).

Tennessee Valley—Fall meeting at Oak Ridge, Tenn., November 4 and 5, with the Oak Ridge Subsection as host.

Texas—Fall meeting at the Texas Hotel, Fort Worth, Tex., October 13–15.

Toledo—Field inspection of a section of the Ohio Turnpike September 14, at 6 p.m. (meet at the Stoney Ridge Interchange), followed by dinner at Dolly & Joe's at 7 p.m.

Scheduled ASCE Conventions

NEW YORK CONVENTION
New York, N. Y.
Hotel Statler
October 24–28, 1955

DALLAS CONVENTION
Dallas, Tex.
Hotel Baker
February 13–17, 1956

KNOXVILLE CONVENTION
Knoxville, Tenn.
University of Tennessee
June 4–8, 1956

BOLTING SPEEDS ERECTION of New Building in Dallas

This graceful new structure is the Adolphus Tower Building, a 30-story office building in Dallas, Texas. Originally its steel frame had been designed for riveted construction, and the two lower tiers were erected in this manner. But to speed up erection, Bethlehem High-Strength Bolts were used to join the remainder of the steel skeleton. This enabled the builder to meet the rapid erection schedule that had been set for the job.

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Bethlehem High-Strength Bolts are made of carbon steel in sizes to meet virtually every construction need. They are heat-treated by quenching and tempering, and meet every requirement of ASTM Specification A-325.

The nearest Bethlehem sales office will be pleased to answer your questions about the use of Bethlehem High-Strength Bolts. Call them today. Or write direct to us at Bethlehem, Pa.

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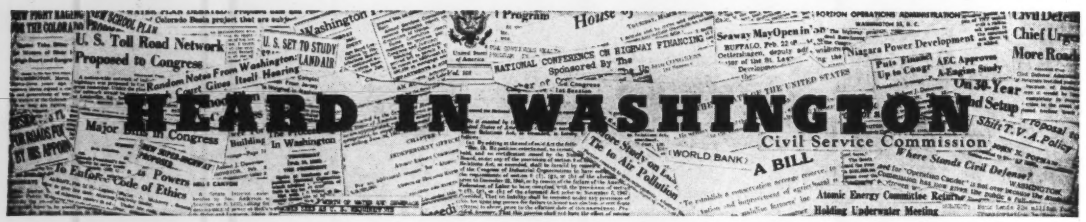
HEARD IN WASHINGTON
U. S. Toll Road Network Proposed to Congress
U. S. SET TO STUDY LAND AIR
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Building In Washington
To Enforce Code of Ethics
Civil Service Commission
A BILL
Chief Urges More Roads
Shift T. V. A. Policy
Atomic Energy Committee Reports
Holding Underwater Meeting

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Scuttling of the "Grand Plan" for Highways

The defeat of **all highway bills** in the House was distressing to the engineering profession, to the highway-using public, and to Congress itself. The Fallon Bill, substitute for the President's plan, provided tax instead of bond financing and offered a 90 percent federal contribution for Interstate system roads. Its overwhelming defeat ended 1955 attempts for a great road program.

At hearings, highway needs were portrayed dramatically and effectively. With all methods of payment rejected, great confusion prevails. No enthusiasm exists for election-year tax bills. One ray of hope: Normal road legislation must be considered in 1956. That may re-spark the drive for a bold new program.

Causes of the Defeat

Why were these bills rejected? What features can be revived? These are important questions for all Americans. The following observations are personal.

House bills emphasized the Interstate system, as recommended by most highway experts. Unfortunately this system bypasses 189 Congressional districts. Result: diluted enthusiasm for it. Southern Democrats, 73 to 15 against the House bill, disliked several features, including Davis-Bacon Act labor provisions. The politically balanced Pennsylvania delegation voted 26 to 1 against it, possibly because of the impossibility of financing toll roads if it became law. The West objected to high diesel fuel taxes. Spokesmen for the trucking industry say they worked to defeat a bad tax bill not a highway bill. Total opposition was thus great.

Elements of Weakness

The **Clay plan** provided a complete program, but was politically weak. It took Congress somewhat out of road programming; included controversial bond features; might have led to a toll-road-building spree. Delayed presentation to Congress gave opponents the initiative. Proof that the Interstate system was an essential defense need was unconvincing.

Logical consequences of the 90 percent (and even 95 percent) federal contribution offered in the defeated bills were not understood, but had indirect adverse effects. The contribution ratio was not dictated by considerations of relative use or benefit. It was an unbalanced ratio for an alleged cooperative enterprise—something in the nature of the proverbial horse and rabbit stew made of one horse and one rabbit. Labor unions were quick to grasp the fact that this was really a federal project and obtained insertion of Davis-Bacon Act labor conditions. Rural and Southern Congressmen, envisaging these as applying eventually to *all* road building, lost some enthusiasm.

With a 90 percent federal gift for a free Interstate system, toll roads would scarcely be able to compete—nor would toll bridges which now get a 60 percent subsidy. The government would have to pay the bill on perhaps several thousand miles of contemplated toll roads proposed for the Interstate system. Such a multi-billion-dollar expenditure for roads that would normally be provided at no expense to the federal government magnifies the financial stumbling block to the legislation. The direct-user-charge idea for providing million-dollar-a-mile highways for areas remote from him still has a logical appeal to the non-user.

Biggest objection to the proposed limited-access interstate roads may come from motel, gas station and other commerical operators who would be displaced; especially in the areas where over half the present mileage would be relocated to meet new standards.

What Can Be Salvaged?

Best assurance for reviving the issue is the irresistible public demand for better and safer highways. Roads will be built despite all—and taxes will pay for them, now or later. An unexpected strong point was the **tacit acceptance** by the motoring public of the **proposed one-cent federal gas tax increase.** This and some other taxes may receive majority support.

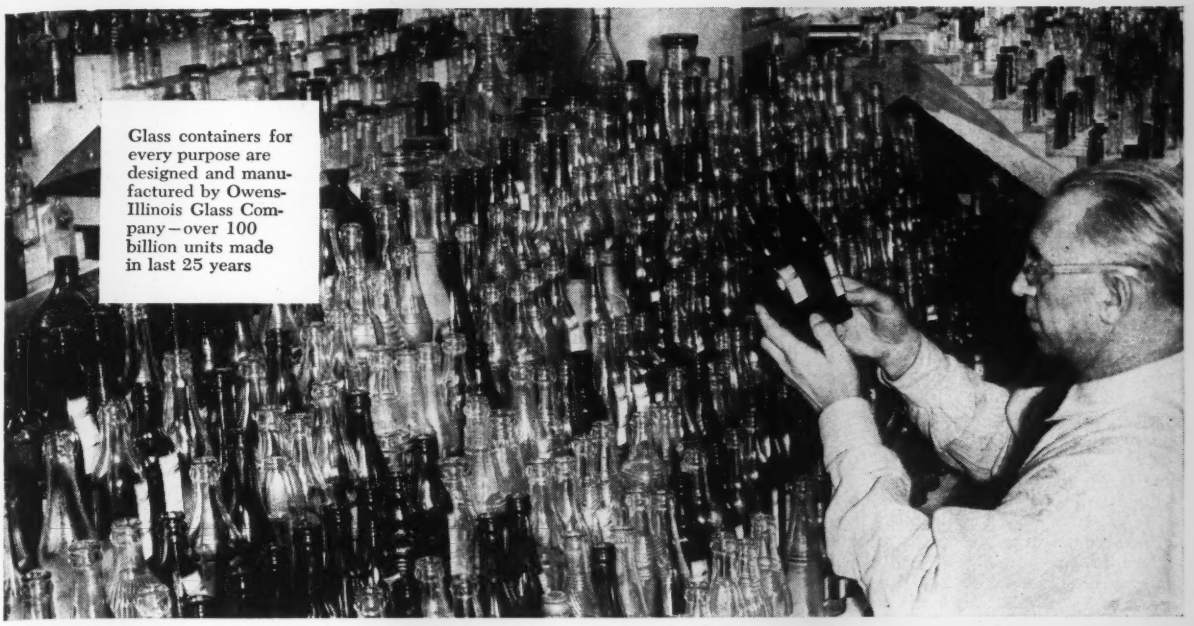
The **Interstate system,** which carries twelve times the average traffic of our road network must be built to high standards. A federal contribution of up to 75 percent would not interfere competitively with normal toll road and toll bridge construction; probably would not necessitate Davis-Bacon labor provisions; would not arouse resentment from representatives of bypassed areas; would permit vast improvements in the system.

If bond financing is used at all it would involve much shorter term bonds as supplement to taxes.

Allocation of Interstate system funds must be on a sounder basis. Urban needs were crudely estimated. Provision might be made for unfreezing the Interstate system, permitting equalizing extensions to it. Relationship between present gas tax receipts and Interstate system needs was shown by California witnesses.

If all interested groups could agree on a bill, compromising dissenting viewpoints, and taking above-mentioned points into consideration, a great highway plan with adequate emphasis on the Interstate system could be approved in 1956.

Washington, D.C.
August 22, 1955



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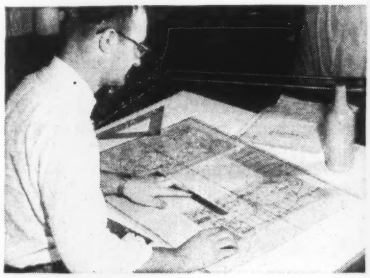

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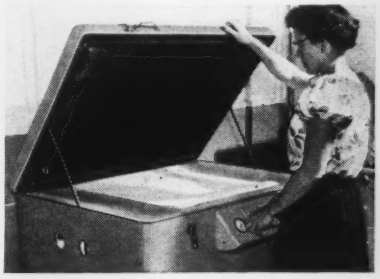

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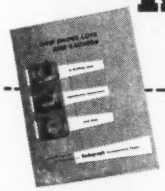

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NEWS BRIEFS . . .

Turnpike Slated for Richmond, Va., Area

Plans to start work next spring on a 35-mile turnpike between Richmond and Petersburg, Va., have been announced by the Richmond-Petersburg Turnpike Authority. Designed to relieve congestion on U.S. Routes 1 and 301, the $67,500,000 facility is expected to cut present driving time between the two cities almost in half. It will be a four-lane thoroughfare with six lanes in the Richmond area. When completed in 1958, the turnpike will be the largest and most costly single highway project ever built in Virginia.

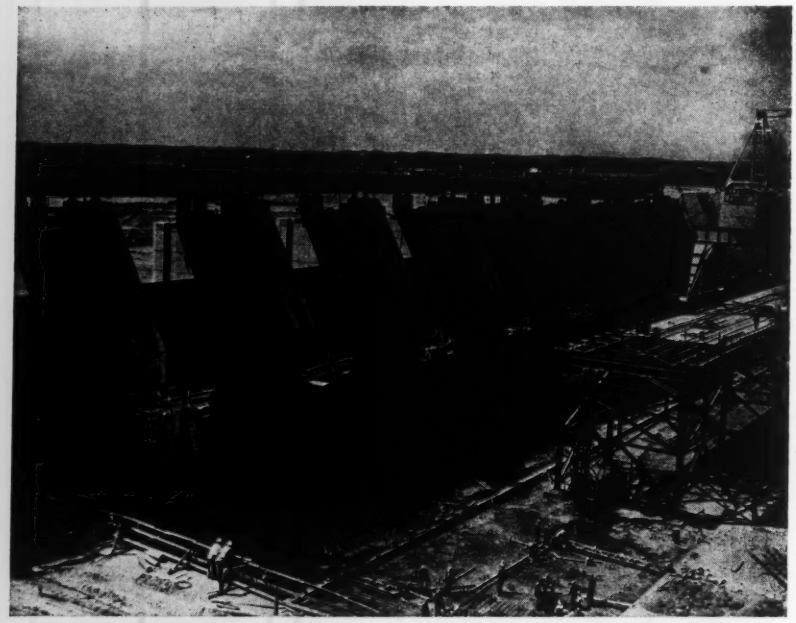
Two other turnpikes are under consideration in the state. They are the Old Dominion Turnpike, a seventy-mile toll road with connections to the West Virginia Turnpike and another toll road in North Carolina, and the Virginia-Carolina Coastal Turnpike, a 53-mile project that would connect the resort areas of Virginia Beach, Va., and Nags Head, N.C.

New Aluminum Company Goes Into Production

A $65,000,000 primary aluminum plant was dedicated by the Anaconda Aluminum Co. at Columbia Falls, Mont., on August 15. The company—fourth aluminum concern in the United States and the first to enter the field in this country since 1946—is planning a program of expansion that will run into several hundred million dollars. The plant has two potlines, each containing 120 pots, in four 1,800-ft pot buildings. One potline is in operation now, and full production by January 1, with an annual output of 60,000 tons, is planned.

The plant will use 120,000 tons of alumina (refined bauxite) a year. The alumina, processed from ore mined in Jamaica, B.W.I., will be shipped to the plant by rail from Corpus Christi, Tex., and Hurricane Creek, Ark. Power for the project will come from Hungry Horse Dam, which is seven miles southeast of the plant.

Gavins Point Dam Nears Completion



Closure of Gavins Point Dam—a rolled earth project under construction on the Missouri River between Nebraska and South Dakota—was effected in a recent nine-day operation culminating on August 4 in ceremonies at which Army Secretary Wilbur M. Brucker was principal speaker. When construction is completed at the end of the year, the dam will begin to function as the fourth of six main-stem control structures being built under the Pick-Sloan Plan. The dam will have a reservoir capacity of 540,000 acre-ft and act as regulator for the mammoth upstream system. Dam, power house, substructure, and spillway are being built under an $18,007,934 contract held by a joint venture consisting of Western, Massman and Jones construction companies.

New Power Station For Yorktown, Va.

The Stone & Webster Engineering Corp., of Boston, has been retained by the Virginia Electric and Power Co. to design and construct a $20,000,000 dual-purpose power station on the York River about six miles east of Yorktown, Va. The station, which will have a capacity of 165,000 kw, will be a functional semi-outdoors type. It will be the first power plant specifically designed to use a new refinery by-product as fuel. The fuel, called "delayed coke," will be supplied by the American Oil Co., which is building a large refinery on adjacent property.

Design work on the project is under way, with completion currently scheduled for July 1957.

Cement Company to Build Southern California Plant

The Permanente Cement Co. will expand its operations into Southern California with the construction of a new $12,000,000 cement plant near Victorville in San Bernardino County. The plant, which will have an initial annual capacity of 2,000,000 barrels of portland cement, is scheduled to begin production in the early fall of 1956. Construction is expected to begin in about ninety days, and bids will be invited as soon as engineering is completed by the Kaiser Engineers Division of Henry J. Kaiser Co., which is designing the facilities and will supervise construction.

Scientific Manpower Shortages Reported

At least half of 200 large companies engaged in research and development—all of them in essential industries—report shortages of research scientists and engineers, according to Alan T. Waterman, director of the National Science Foundation. Speaking at Columbia University's recent sixth annual conference on industrial research at Harriman, N.Y., Dr. Waterman made public preliminary findings of a study of industrial research being made by the Bureau of Labor Statistics as part of the Foundation's national survey of scientific research and development.

Dr. Waterman said that the 200 companies interviewed in the study employ a substantial proportion of all scientists and engineers engaged in industrial research. About two-thirds of the companies reporting shortages said they were major shortages. All agreed on the need for better qualified, more highly trained scientists and engineers. A sizable number of firms said they had been forced to curtail projected increases in their research and development programs because of lack of qualified personnel.

Dr. Waterman also disclosed that the Foundation is sponsoring a series of fact-finding studies that will provide more complete data on the supply and demand of technical personnel than has hitherto been available.

Arizona Starts Highway Engineer Training Program

The Arizona Highway Department has authorized an "Engineer-in-Training" program and earmarked $25,000 for its first year of operation. The program has a dual purpose—to prepare replacements for vacancies resulting from retirement and to get ready for an expanded federal-aid highway construction program.

Five young graduate engineers will be trained in the first year of operation. Interested persons should get in touch with C. B. Browning, Deputy State Engineer, Arizona Highway Department, Phoenix, Ariz.

Precast Concrete Roof Decking in Wide Use

A recent survey of the use of non-combustible precast concrete roof decking shows that a grand total of 202,577,676 sq ft of such decking has been installed in the past ten years for 6,063 owners. This square footage was supplied by nine firms which manufacture more than 80 percent of all the precast concrete roof decking produced.

Schools and universities led the list in frequency of preference and use of the precast roof slabs and planks. The automotive industry, with almost 30,000,000 sq ft, was the largest single user during the period. The industry was only fifth, however, in the number of locations where such decking was installed.

The steadily increasing emphasis on fire-resistant building is one of the reasons cited for the popularity of the decking.

Pennsylvania Power Co. To Build Atomic Plant

Charles E. Oakes, president of the Pennsylvania Power & Light Co., has informed Admiral Lewis L. Strauss, chairman, and Gen. K. E. Fields, general manager of the Atomic Energy Commission, of his company's decision to build a privately financed atomic-electric power plant of at least 150,000 kw. A site in the company's service area is to be chosen for the project, which will utilize the homogeneous-type reactor. The AEC is expected to grant the necessary licenses.

"In the homogeneous reactor," Mr. Oakes said, "the fuel is in liquid form. This liquid, in addition to containing the radioactive fuel, also includes coolant and moderator to control the fission process. The liquid circulates freely throughout the nuclear plant's system and carries heat to steam generators. Steam from the generators spins turbines which produce the electricity. The use of the liquid fuel system will permit the reactor, or atomic furnace, to operate continuously as new liquid nuclear fuel can be added while the reactor is running."

The in-service date for the new unit is planned for 1962.

Charlotte, N. C., Coliseum Has World's Largest Dome

Construction of an ultramodern coliseum, with an immense dome-shaped aluminum roof rising 120 ft above street level, nears completion in Charlotte, N. C. Part of a civic project, the structure will be used as a games and exhibition center. It will provide a 99 × 212-ft arena and seating capacity for 13,500. The spectacular dome—believed to be the largest of its type in the world—has no supporting pillars except around the circumference of its two-acre area, assuring spectators in the auditorium an unobstructed view. Basic construction of the dome involves a steel-ribbed web frame overlaid with preformed concrete. The dome surface consists of 3,665 pieces of aluminum, stretching in a convex latticework from a steel tension ring around the circumference of the dome to a central compression ring. Architect for the project was A. G. Odell, Jr., and Associates, Charlotte. Thompson & Street of Charlotte were the general contractors. Aluminum sheet was supplied by the Aluminum Company of America's Alcoa, Tenn., works, and roof fabrication and installation was handled by Aluminum Structures, Inc., of Pittsburgh.

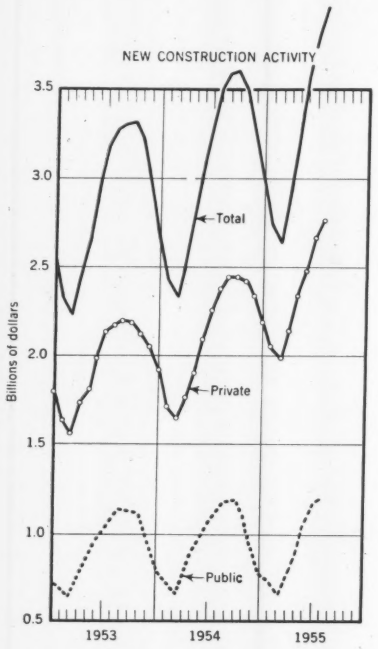
Construction Activity Sets New Record in July

The value of new construction put in place rose seasonally in July to a new monthly peak of nearly $4 billion, and reached a record total of $23.1 billion for the first seven months of the year, according to preliminary estimates prepared jointly by the Departments of Commerce and Labor. After adjustment for seasonal factors, new construction activity in July was at an annual rate of $42 billion.

Most of the June-July increase (4 percent) resulted from expansion in private residential and commercial building and highway work. Outlays for almost all other types of construction remained at their high June levels or rose slightly.

For the third successive month total private construction reached a new high. The 2.8 billion total for July was 4 percent above June and 16 percent higher than in July 1954. Public construction activity, at $1.2 billion, was 5 percent greater than in June, but only slightly above the level of July 1954 as gains—primarily in public educational buildings, military facilities and highway work—were nearly offset by a substantial drop in activity on atomic energy projects, and lesser declines in public housing, hospital, and conservation and development work.

Comparing the record volume for January-July 1955 with that for the first seven months of 1954, private construction expenditures (16.5 billion) were 20 percent higher, despite declines in private school building, railroad, and farm construction. Public outlays ($6.5 billion) were virtually the same.



New construction rises seasonally in June to new monthly high of nearly $4 billion, bringing total for first seven months of the year to a record $23.1 billion.

Tacoma, Wash., Gives Contracts for Turbines

A $1,750,000 contract for construction of four hydraulic turbines has been awarded by the City of Tacoma to the S. Morgan Smith Co., of York, Pa. The new turbines, of the Francis type, will be rated at 55,000 hp each under a 185-ft head. They are to be vertical shaft machines with solid cast runners and plate steel spiral casings. The new units will be installed at the city's Mayfield Plant on the Cowlitz River near Tacoma.

Robert W. Shearman Named to AIME Staff

Robert W. Shearman has started work as secretary of the Metals Branch of the American Institute of Mining, Metallurgical and Petroleum Engineers at AIME headquarters in New York. In this capacity he will be responsible for the tremendous work load involved in serving the Institute's thousands of member metallurgists. Mr. Shearman is a graduate of Princeton University, with degrees in chemistry and metallurgy, and has been with the Pittsburgh Plate Glass Co., Bethlehem Steel, and the Union Carbide & Carbon Co.

Record for Underwater Concrete Placement Established on Mackinac Bridge Project

Setting a new world record for underwater concrete placement highlights construction work on the substructure for the Mackinac Bridge project. During one 24-hour period in May 6,250 cu yd were placed, while production for a five-day run was 22,378 cu yd. All concrete for the foundation piers is being placed by the Prepakt method by the substructure contractor, Merritt-Chapman & Scott Corp. The Prepakt Concrete Co. is assisting in the placement of some 450,000 cu yd of Prepakt concrete in the 34 piers, some of which extend over 200 ft below the water surface. On schedule for a projected completion date late in 1957, the Mackinac Bridge will be the world's longest suspension span from anchorage to anchorage. New York Consultant D. B. Steinman, M. ASCE, is the designing engineer, and Grover C. Denny project manager for Merritt-Chapman & Scott.

New Zealand Completes First Major Prestressed Bridge

W. G. MORRISON, M. ASCE
Consulting Engineer Wellington, N.Z.

Recently completed near Wellington, N.Z., is the Hutt Estuary Bridge. Made of prestressed concrete, the structure is the first major bridge of its kind in New Zealand, though numerous small prestressed concrete bridges are being built.

The superstructure consists of five 105-ft spans simply supported on the piers and abutments, each span comprising 16 beams side by side forming a deck 53 ft 9 in. wide overall. It provides a 30-ft footway, a 6-ft footway, and a serviceway 11 ft 6 in. wide to carry large water mains. The bridge is on a 11-deg skew.

The 80 nearly identical beams required were cast on the bank, each incorporating seven precast diaphragms set on the skew. The beams were prestressed by the Magnel system, using 96 wires per beam of 0.267-in. dia. After the cable ducts had been grouted, the beams which weighed 40 tons each were skidded transversely on steel rails to stock. The first few beams were lifted off their beds by a "cherry picker" and placed on Athey wagons for transfer to stock. In spite of warnings to keep beams upright, one of the wagons lurched into a depression and tipped a beam onto its side. The beam virtually exploded under release of prestress and in so doing "touched off" another beam which was already in stock. It also broke into fragments.

Launching and placing consisted of transferring the beams to bogie trucks operating on a 6-ft-gauge railway line laid on a timber construction trestle parallel to the bridge. When they were opposite the required span, the beams were slid transversely into final position on the pier tops. A proposed method of floating the beams into position was abandoned on account of shallow water under the end spans.

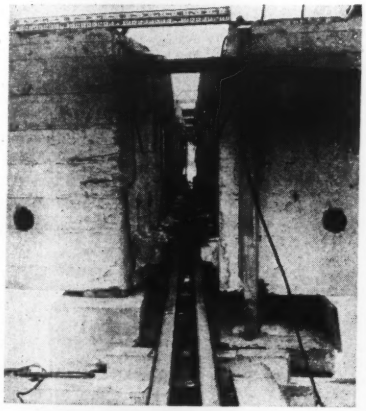
Concrete was cast in place between beam flanges and the precast diaphragms, then the diaphragms were prestressed with 16 Magnel wires. The deck slab was prestressed transversely by means of 1-in. Lee McCall bars at 3-ft centers to a calculated concrete stress of 310 psi not allowing for losses.

Concrete was carefully controlled and frequently tested, but no attempt was made to use a very dry mix. The concrete was premixed at a central plant and transported to the site in agitator trucks. Two sizes of aggregate—one part of coarse sand and a small proportion of fine beach sand—were used with 750 lb of cement per cu yd. The design strength on a 12 by 6-in. cylinder was 5,100 psi, but nearly 20 percent of the tests were somewhat below this figure at 28 days. Beam deflection under a test load, cambering of beams under prestress, and direct measurements on a cylinder, all indicated a modulus of about 4,600,000 psi.

Piers Give Trouble

The river bed in mid channel consists of variable layers of gravel, sand and shells about 20 ft thick overlying a uniform bed of marine clay 16 ft thick. Below the clay are important artesian measures with a pressure about 14 ft above mean river level. To avoid disturbing this artesian water source, piers were founded on the clay. The first pier was successfully constructed in a sheetpile cofferdam 62 by 20 ft. Frodingham No. 2 piles, 50 ft long, were used. The second cofferdam, however, behaved in a very unusual manner. It was pumped out and excavated ready for concrete when the whole cofferdam suddenly rose 15 in. The movement was very local in that timber piles only 2 ft away were not affected. The bottom of the excavation remained level, and there was no evidence of the escape of artesian water. The conclusions are that the clay failed in the tension under bending stresses. The cofferdam was flooded, sufficient tremie concrete was placed under water to balance the artesian head, and the pier was completed without further trouble. Subsequent settlement during the concreting of the pier and superstructure was 5 in. Thus 10 in. of uplift remains unaccounted for. Nevertheless, settlement during the year since completion of the work has been negligible.

After the experience with this pier the



Beams, 16 per span, were slid transversely onto the piers from a construction trestle parallel to the bridge (upper view). Crossing is on a 11-deg skew.

Recently completed Hutt Estuary Bridge near Wellington, N.Z., is New Zealand's largest prestressed structure. It replaces the old wooden bridge, shown in the foreground. On left bank is the yard where 80 nearly identical beams were cast. Each beam weighs 40 tons.

cofferdam method was abandoned and the remaining two piers were sunk as concrete caissons.

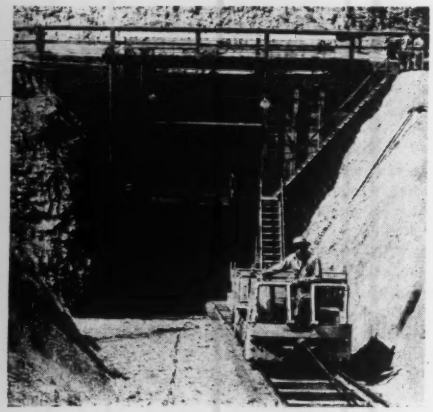
The construction was undertaken by a selected firm of contractors, Wilkins & Davies Construction Company, on a "target contract." The contract set a target price mutually agreed between the engineer and the contractors. The arrangement was that if the work was done for the target price the contractors would be paid a fee of 10 percent plus agreed overhead costs. For every £1,000 that the job cost exceeded the target the fee would be reduced by £300 with a limiting fee of 3 percent. On the other hand, for every £1,000 that the cost was less than the target, the fee would be increased by £500. Unfortunately due to various difficulties the final cost considerably exceeded the estimate, and the contractors were entitled under the contract to the minimum fee.

The work took 26 months to complete, and pier construction was throughout the key to progress. Beam production could have been speeded up whenever necessary. Had caissons been used for all the piers as for the last two, the bridge could have been completed in 15 months. However, heavy construction plant is very scarce in New Zealand. Had even such common items of plant as boilers, winches, floating cranes or barges been available as they are in the United States or Western Europe the work would have been much easier and faster.

The overall contract cost was £243,000 divided equally between foundations and superstructure or £8.6s per sq ft of deck. Approaches, test borings, and engineering costs are not included.

The bridge was designed and supervised by the writer. The work is fully described in a technical paper in the November 1954 issue of *New Zealand Engineering*, a publication of the New Zealand Institution of Engineers.

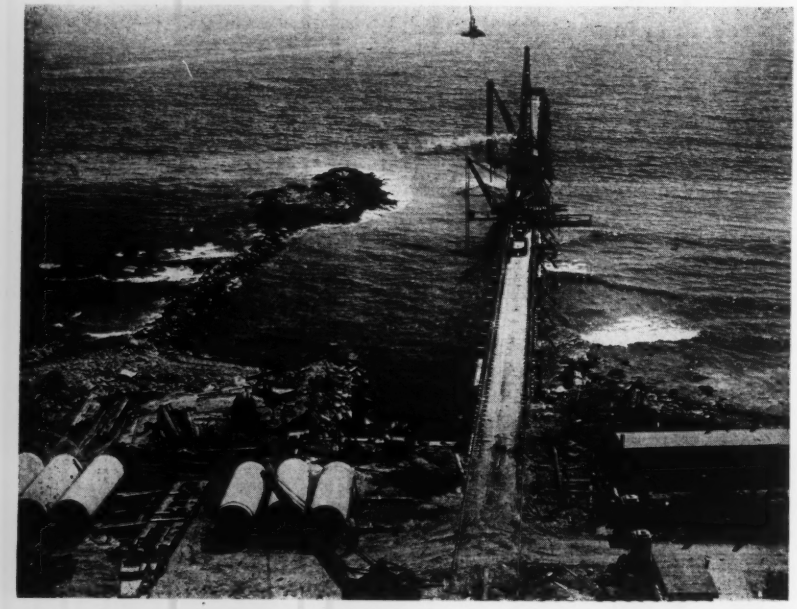
[*Before opening his Wellington office, the author, a graduate of the University of New Zealand, had his early experience in British Columbia, California, New Zealand, England, Egypt and India.*]



Sewer Outfall for Pasadena Garbage Disposal

Here construction crews are boring an 8,500 ft shaft through a bluff, final leg of the 32,000-ft tunnel that will carry the new 90-in. sewer main to the disposal plant. Photos courtesy of "Pasadena Star-News."

New 90-in. sewer outlet, which the Los Angeles County Sanitation District is building at White's Point near San Pedro, is expected to provide Pasadena and adjacent metropolitan areas with a smog-free method of disposing of combustible garbage. The trash will be ground up and flushed into the sewer, which will connect with the disposal plant at San Pedro. When the project is completed in about two and a half years, the sewer will discharge 400 cfs of waste products into the Pacific 8,000 ft from shore. In this general view cranes and barge are digging an underwater trench to hold the sewer outlet. The project was the objective of a recent field trip of the Los Angeles Section's Sanitary Engineering Section, which supplied information and photos.



Ohio to Have First Pipeline for Coal

The nation's first commercial coal pipeline will be built by the Pittsburgh Consolidation Coal Co. for use in delivering 18,000,000 tons of pulverized coal to the Cleveland Electric Illuminating Co. in the next fifteen years. The fuel will be pumped from the coal company's Georgetown, Ohio, properties to the Eastlake, Ohio, plant of Cleveland Electric, a distance of 108 miles. In 1951 the Pittsburgh Consolidation Coal Co., largest company of its kind in the world, built a $550,000 test line at Cadiz, Ohio, to assure the efficacy of the unique coal-hauling method. Estimated cost of the project will be $8,000,000 to $10,000,000.

Colombia in "Atoms for Peace" Program

A chance to take part in the President's "Atoms for Peace" program was offered the Colombian government at a recent meeting at which representatives of Colombia and the United States initiated a proposed agreement for cooperation in the field of research in peaceful uses of atomic energy. The proposed agreement will enable Colombians to acquire in their own country valuable training and experience in nuclear science and engineering including the development of nuclear power.

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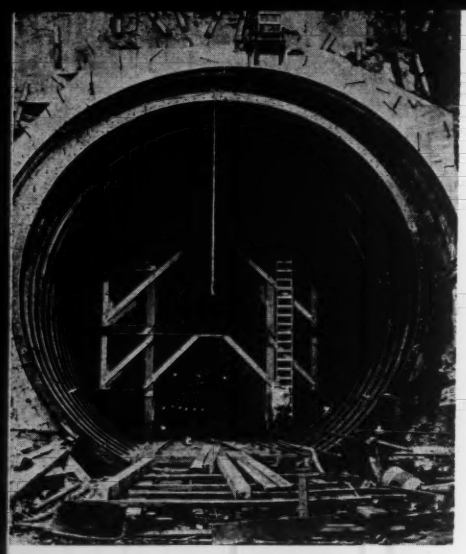

Giant Steel Liner Installed in New Lincoln Tunnel Tube

Workmen install steel waterproofing liner in the Palisades section of the third tube of the Lincoln Tunnel, a project of the Port of New York Authority. The steel lining, shown in place at the end of the ventilating shaft, was fabricated in ring segments—5 ft wide and 32 ft, 10 in. in dia—by Baldwin-Lima-Hamilton Corp., of Philadelphia, for Mason-Johnson-MacLean, Weehawken, N.J., prime contractors on the tunnel. For convenience in handling, the rings were made in ten equal one-ton segments with one segment containing a small filler or key section. A hydraulically operated rotating arm mounted on a movable scaffold, similar to that shown, lifts each ring segment, raises it into position, and holds it in place until workmen insert and tighten the holding bolts. The immensity of the bore, which is large enough to enclose a two-story building, is apparent when it is compared to the workman climbing the scaffold ladder. Top and bottom segments of the bore will serve for exhaust and fresh air passages, and center section will be used for the roadway.

N. G. Neare's * COLUMN *

R. ROBINSON ROWE, M. ASCE

"Look," beckoned Professor Neare, "at the figures Joe's putting on the blackboard. If that's his record of beers for last month, August 3 must have been a scorcher!"

2	2	4	12	2	24
3	5	15	13	1	13
4	4	16	14	1	14
5	3	15	16	1	16
6	3	18	17	1	17
7	2	14	18	1	18
8	2	16	20	1	20
9	2	18	24	1	24
10	2	20	31	1	31
11	1	11	Total 36		324

"Not a beer all month," grumbled Joe Kerr. "Spent all my snack dowry on your game of 'Yippy,' and this is the score. Twice I yippied for a 2-dime pot, but the 31-dimer and most of the big ones went to Bardie Taylor. After 36 games, averaging exactly 9 dimes per pot, I was broke but had the answer."

"I asked for 1000 games and warned you to play with matches," fumed the Professor. "This wont be much of a check of Cal's 'Exact' method."

"You needn't check me," bragged Cal Klater. "According to your rules for Yippy, each player in turn antes a dime and casts a die, adding the pips to his opponent's last call, much as in cribbage except that game is 11 instead of 31 and there is no 'go.' If the cast can't be added without passing 11, then the cast must be subtracted. For example, if A has called '9' and B casts 1, he calls '10'; if he casts 2, he calls 'Yippy' and rakes in the pot; but if he casts 3, he calls '6.' O.K.?" "Okeh," checked the Professor.

"So I solved by letting $x, a, b, c, \ldots j$ be the probable number of plays to the finish after the call reached 0, 1, 2, 3, . . 10 respectively. Now then, in the same example, after A has called '9,' the probable number of plays to the finish is i and the 6 equally probable casts will lead to the 6 equally probable calls of 10, Yippy, 6, 5, 4 or 3, for which the probable number of remaining plays will be j, 0, f, e, d or c respectively. Counting B's plays,

$$i = 1 + \frac{1}{6}(j + f + e + d + c)$$

Then, with a similar derivation for each call, I found the following set of 11 equations in 11 unknowns:

$$\begin{aligned}
6x - a - b - c - d - e - f &= 6 \\
6a - b - c - d - e - f - g &= 6 \\
6b - c - d - e - f - g - h &= 6 \\
6c - d - e - f - g - h - i &= 6 \\
6d - e - f - g - h - i - j &= 6 \\
6e - f - g - h - i - j &= 6 \\
6f - g - h - i - j - x &= 6 \\
6g - h - i - j - a - b &= 6 \\
6h - i - j - b - c - d &= 6 \\
6i - j - c - d - e - f &= 6 \\
6j - d - e - f - g - h &= 6
\end{aligned}$$

The answer, x, in dimes, can be expressed directly in determinants; reducing, I found . . . ."

"Wait, wait," commanded Joe Kerr. "Dont spoil it for me. I'd rather solve those equations than play 964 more games with Bardie."

"All right," agreed Professor Neare. "I'll save my new problem about needles in haystacks until next month. Joe can fool with Cal's equations and Cal, you'd better be sure you're right and that your way is easiest."

[*Several Cal Klaters asked for more time, pleading vacations and humidity, and Joe really asked for it*].

NUCLEAR NOTES

XIV—Identification of Radioisotopes by Relative Counting Techniques

This installment of "Nuclear Notes" was prepared by Morton I. Goldman at the request of the Sanitary Engineering Division's Committee on Sanitary Engineering Aspects of Nuclear Energy. Mr. Goldman is Senior Assistant Sanitary Engineer, Robert A. Taft Sanitary Engineering Center, U.S. Public Health Service, who is assigned to the Oak Ridge (Tenn.) National Laboratory. Conrad P. Straub, of the Oak Ridge National Laboratory, heads the committee, which also includes Earnest F. Gloyna, A. E. Gorman, Prof. Warren J. Kaufman, Alexander Rihm, Jr., and James G. Terrill, Jr. Next month's subject will be: Theory of Shielding.

Relative counting techniques described in previous articles (Nuclear Notes XI and XII) may be used to identify radioisotopes. Through their use, some of the more important characteristics of a radioactive substance such as half life, and energy of beta or gamma emission may be determined.

The half life of a radioisotope is found by comparing the activity of a sample measured under identical conditions at successive time intervals. Since the disintegration rate is proportional to the number of radioactive atoms present at any instant, the change in measured activity will indicate the change in the number of radioactive atoms present. Where these measurements extend over a considerable period of time, one should

(*Continued on page 92*)

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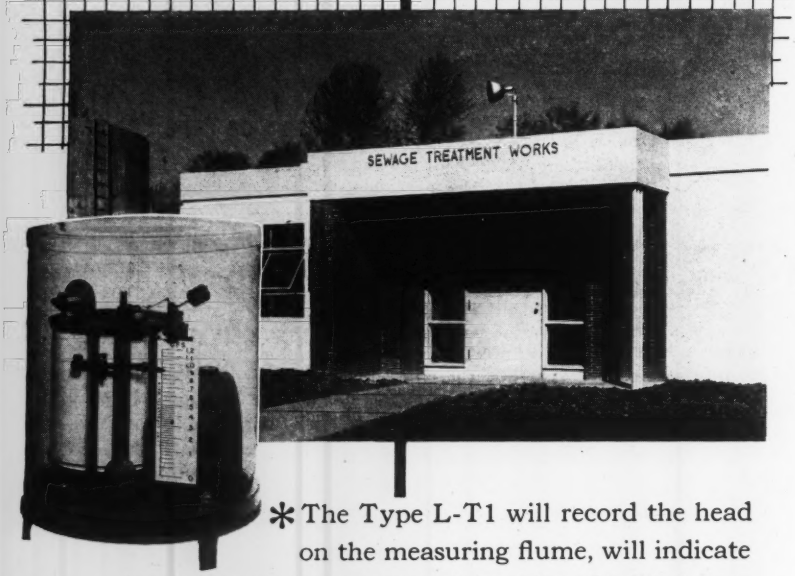

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Nuclear Notes

(*Continued from page 86*)

compensate for any changes in counter operation. This can be ascertained by the use of a long-lived standard. Since the decay of a single radioisotope follows an exponential relationship (See Nuclear Notes V), the logarithm of the activity plotted against time results in a straight line. Activity measurements at two times should provide sufficient data from which to draw a straight line. The slope of this line gives the negative of the decay constant ($-\lambda$). In practice, however, it is common to take a series of these measurements and determine the line of best fit. This method can be used for isotopes which have half lives ranging from several hours to several years.

If several isotopes with widely different half-lives are present in a sample, the individual decay rates can be determined by a process of extrapolation and subtraction. In this case, the final exponential decay of the longest-lived isotope is extrapolated back to zero time and its contributions to the total activity at a series of times subtracted from the total. These differences, when plotted on semi-logarithmic graph paper should result in a straight line if there are only two isotopes in the original mixture, as indicated in Fig. 1. If not, and it is possible to discern an exponential decay in the longer-lived component remaining, the process of extrapolation and

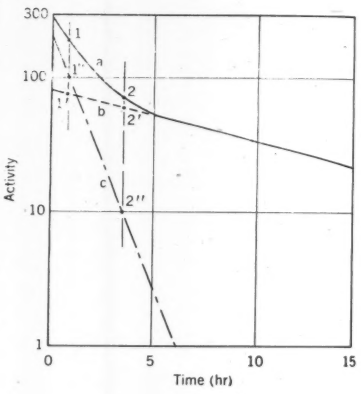

FIG. 1

subtraction may be repeated. From these individual exponential decay curves, the time required to effect a 50 percent reduction in activity (one half-life) can be found. Most frequently this procedure is limited to samples with no more than two components. The kind of counter selected depends upon the kind of radiations present in the mixture being counted.

In the determination of beta and gamma energies, absorbers of known thickness (grams/cm²) are inserted between the sample and the detector (most usually an end-window G-M counter) and the percentage transmission through the absorber is observed. Lead is most frequently used as the absorber in the determination of gamma energy, and the absorber is placed as close to the source as possible. The source is placed as far as feasible from the detector which is shielded by

(*Continued on page 94*)

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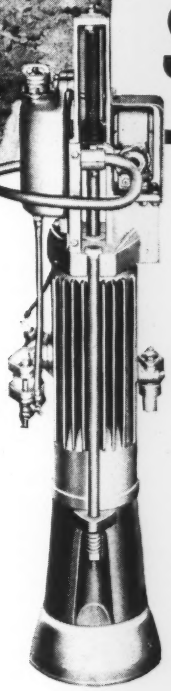

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Nuclear Notes

(*Continued from page 92*)

an aluminum absorber (about 1 gram/cm²) to eliminate beta particles and secondary electrons resulting from gamma ray interactions. In the case of electromagnetic radiation (gamma radiation) attenuation follows an exponential law. Therefore a plot of activity (or percent of activity transmitted) on a log scale against absorber thickness on a linear scale will result in a straight line from which the half-thickness (that thickness which will reduce the original activity by a factor of two) can be found directly. By reference to suitable tables or graphs (*1a*) this half-thickness value can be used to determine the gamma photon energy. When two components are present and there is sufficient difference in their energies, they may be resolved into two straight lines by the method of extrapolation and subtraction described earlier.

Beta particle energies may also be determined by absorption studies. In this determination aluminum absorbers calibrated in mg/cm² are usually employed; the absorbers and source are placed as close to the detector as possible. Analysis of the resulting absorption curve is more difficult than in the case of gamma radiation, since the attenuation of beta radiation does not follow an exponential relationship. The shape of the beta absorption curve depends upon the distribution of energies in the particular beta spectrum, and the scattering characteristics of the particular counting arrangement. A sample mounted on aluminum will produce a different absorption curve than the same sample mounted on copper, because of the difference in backscatter from the two source supports. Generally, the beta-absorption curve approaches a straight line on semi-logarithmic paper for low values of absorber thickness. When beta spectra of different energies are present, the change in slope of the first portion of the curve will make this evident. Ideally, the maximum beta energy in a given spectrum is the value desired from absorption curves. This corresponds to the maximum absorber thickness through which the beta particles will penetrate. This maximum range is difficult to obtain by visual inspection of an absorption curve because of the masking effect produced by background radiations and other penetrating radiations that may accompany the emission or degradation of the beta particles. A better indication of the maximum range can be obtained by subtracting this penetrating radiation contribution from the total and plotting the difference (*2*). The most accurate method of determining the maximum range from absorption curves is the "Feather analysis" (*1b, 3*), which involves the comparison of the sample curve with the absorption curve of a standard beta emitter measured under identical conditions. Once obtained, the maximum range of the unknown can be applied in a range vs. energy curve (*1c*) to determine the maximum range of the beta spectrum.

Because of the difficulty of determining the maximum range of a beta spectrum from an absorption curve, a half-thickness obtained from the first portion of the curve is frequently used as a reasonable estimate of the energy (*1d*). In using values of half-thickness to estimate beta energies, conditions of measurement should be, in so far as possible, identical to those used in obtaining the values listed in tables or plotted on graphs. Although the maximum range is unaffected, the shape of that portion of the curve from which a half-thickness is taken will be altered by a change in the conditions of measurement.

In summary, counting instruments can be used to identify radioisotopes by determining such characteristics as half-life and beta and gamma energies. Half-lives are determined by noting the rate of change in measured activity with time; radiation energies by noting the change in activity measured through a series of suitable absorbers; lead for gamma and aluminum for beta radiations.

References:

1. Radiochemical Studies: *The Fission Products*, Book 1, Division IV, Volume 9, Nuclear Energy Series, Edited by C. D. Coryell and N. Sugarman, McGraw-Hill Book Co., Inc., New York (1951). (*a*) pages 20-21, (*b*) pages 14-17, (*c*) page 13, and (*d*) page 18.
2. *Introduction to Radiochemistry* (Chapter VII). G. Friedlander and J. W. Kennedy. John Wiley and Sons, New York (1949).
3. "Determination of the Energy of Beta Particles and Photons by Absorption," Lawrence E. Glendenin, *Nucleonics*, Vol. 2, No. 1, pages 12–32.

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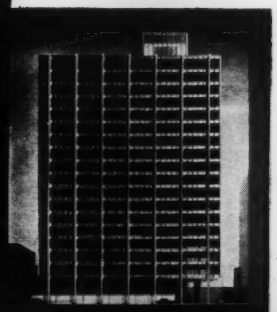

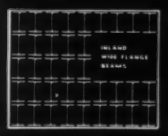

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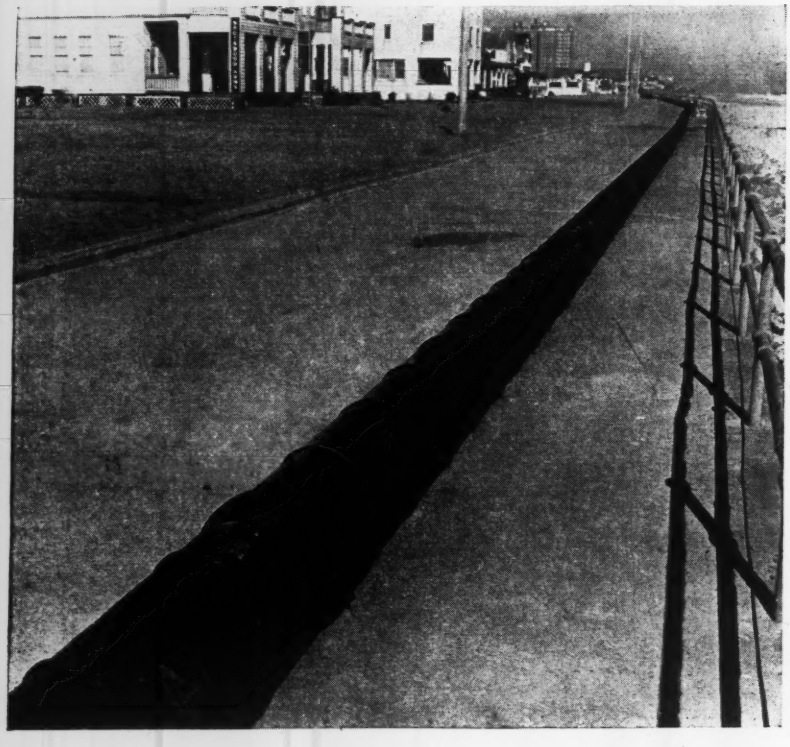

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The Readers Write . . .

(This department begins on page 58)

weight, say up to 12 or 15 stories. The method is best known for its failures rather than for its successes.

I do not know of any case, either in Mexico or elsewhere, in which this method has been tried for underpinning. It would seem to me that even if the desired result could be guaranteed—and experience in Mexico City offers no certainty that it would succeed—the cost of temporarily supporting so heavy a building during the excavation below the mat would be enormous.

It would be necessary, I think, to do a complete job of underpinning before one could safely start to dig for the supporting tanks. The underpinning by itself would fully accomplish the support of the building against the shear settlement, and also against the general settlement, or that major part of this general settlement which is due to shrinkage of the soil above the stratum to which the underpinning would reach, more than a hundred feet below the surface elevation.

J. H. THORNLEY, M. ASCE
President, Western Foundation Corp.

New York, N.Y.

Camber in bridge stringers due to vertical curve

TO THE EDITOR: In the June issue, Engineers' Notebook, page 60, Captain Preston submitted an article entitled "Intermediate Elevations on Vertical Curves Found by Addition of Increments." I wish to point out that his method can be further developed to give an easy formula for the calculation of the required camber in bridge stringers due to vertical curve.

You will recall his formula,

$$\Delta = [L_2 - L_1] \times \left[G_A + \frac{G_B - G_A}{2L} (L_2 + L_1) \right]$$

Δ = difference in elevation between the two selected stations
G_A = slope of tangent into vertical curve
G_B = slope of tangent out of vertical curve
L = length of vertical curve
L_1, L_2 = distances from origin to the two selected stations

We can denote the quantity $\frac{G_B - G_A}{2L}$ by C, the vertical curve constant, as it is determined immediately from the vertical curve data, and is the same for all points on the curve.

It can be easily shown that C is also equal to BD/L^2 (see Fig. 1). This last form is more familiar to most of us, as it is the

(*Continued on page 100*)

Shining Beauty at Detroit Technical Center

The outstanding beauty shown above is a special 250,000-gal. elevated water tank erected to insure an ample water supply under adequate pressure for fire protection for an installation north of Detroit. The structure has an overall height of 138 ft. and was designed, fabricated and erected by Chicago Bridge & Iron Company. Constructed of highly-polished stainless clad steel on the outside it harmonizes with the materials, architecture and landscaping of the Technical Center.

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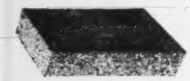

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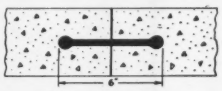
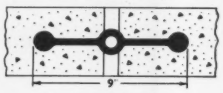


Flat Dumbbell Type



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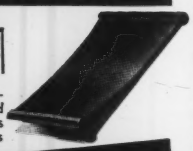

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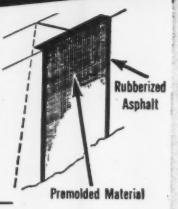

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The Readers Write . . .

(This department begins on page 58)

(*Continued from page 98*)

one which is employed in the more common method of determining vertical curve elevations, that based on the fact that the offsets from the vertical curve to the tangent are proportional to the squares of the distances from the origin.

In Fig. 1, determine v, the camber at the midpoint of l, the stringer 1–3, due to vertical curve:

$$v = \Delta_2 - {}^1/_2\Delta_3$$

$$v = (L_2 - L_1)[G_A + C(L_2 + L_1)] - {}^1/_2(L_3 - L_1)[G_A + C(L_3 + L_1)]$$

$$L_2 - L_1 = \frac{l}{2};\quad L_3 - L_1 = l$$

$$v = \frac{l}{2}G_A + C\frac{l}{2}(L_2 + L_1) - \frac{l}{2}G_A - C\frac{l}{2}(L_3 + L_1)$$

$$v = C\frac{l}{2}(L_2 - L_3) = \frac{Cl^2}{4}$$

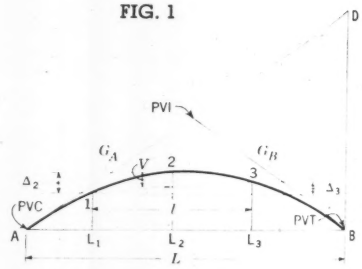
Camber formulas:

$$v\ (\text{midpoint}) = \frac{Cl^2}{4}$$

$$v\ (\text{quarter point}) = {}^3/_4 \times \frac{Cl^2}{4} = {}^3/_{16}Cl^2$$

where $C = \dfrac{G_B - G_A}{2L}$ and l = length of stringer

FIG. 1



Example: A bridge is on a vertical curve, in which $G_A = +3$ percent, $G_B = -5$ percent, and $L = 800$ ft. The length of the stringer is 80 ft. Find the amount of camber required by the vertical curve.

$$C = \frac{G_B - G_A}{2L} = \frac{0.03 + 0.05}{2 \times 800} = 5 \times 10^{-5}$$

$$V\ (\text{midpoint}) = \frac{Cl^2}{4} = \frac{5 \times 10^{-5}}{4} \times (80)^2 = 0.080\ \text{ft}$$

$$V\ (\text{quarter point}) = 0.75 \times 0.080 = 0.060\ \text{ft}$$

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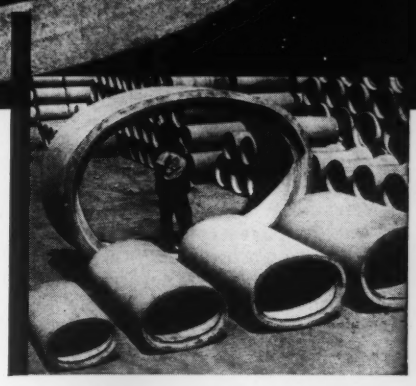

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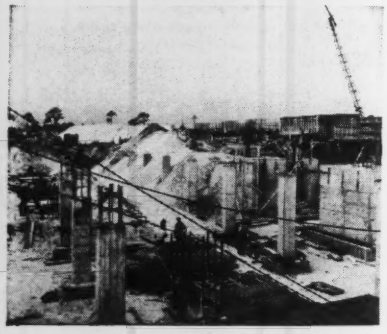

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DECEASED

Thomas Spencer Cassedy (M. '49), age 50, associated with Whitman, Requardt and Associates, consulting firm of Baltimore, Md., since 1940 and partner in the firm for the past seven years, died on August 1. Following graduation from Union College in 1926, Mr. Cassedy was employed successively by Fuller & McClintock in New York City, and the Hudson River Regulating District Staff and Barker & Wheeler, both at Albany, N.Y. In 1936 he became staff engineer for the Farm Security Administration, Washington, D.C., and later was engaged by the Glenn L. Martin Company as a private consultant for developments in Maryland. During the past war he served three years in the Armed Services as a commissioned officer in the Sanitary Corps.

Alfred Lewald (M. '30), age 69, president of Alfred Lewald, Inc., St. Louis, Mo., from 1926 until his retirement in 1947, died on June 20. Before starting his own business, Mr. Lewald was associated with the St. Louis Street and Sewer Department, the E. B. Fay Company for construction of the Municipal Bridge across the Mississippi River at St. Louis, the Kamp-Lewald Company and the Moreno-Burkham Company, all of St. Louis. Mr. Lewald was treasurer of the Asphalt Paving Company of St. Louis from 1929 to 1947. He graduated from Washington University in 1907 and recieved a C.E. degree there in 1915.

James MacGregor MacMartin (M. '15), age 89, retired chief engineer of the Delaware and Hudson Railroad, died in Albany, N.Y., on June 3. A graduate of Rensselaer Polytechnic Institute, class of 1887, Mr. MacMartin joined the railroad company in 1890 holding the post of chief engineer for forty years. From 1912 until his retirement in 1939, he was also chief engineer of the Wilkes-Barre Connecting Railroad.

Harmon Stimbert Meissner (M. '44), age 55, with the Bureau of Reclamation at Denver, Colo., for twenty-five years, most recently as head of the Structural Properties of Concrete and Foundations Section, died on July 22. After graduation from Utah University in 1922, Mr. Meissner worked for the Southern Pacific Railroad Company and for five years was assistant and associate engineer for the Interstate Commerce Commission, Washington, D.C. Mr. Meissner was responsible for establishing a laboratory for research on low-heat cement used in construction of Hoover Dam after joining the Bureau in 1930. He received a B.S. degree from the University of Utah in 1922 and an M.S. degree from George Washington University in 1929.

Robert Hall Merrill (M. '17), age 74, retired consulting engineer of Grand Rapids, Mich., died on June 5. A 1902 graduate of the University of Michigan, Mr. Merrill was assistant engineer for the New York State Barge Canal from 1905 to 1918 when he went to China for three years work as assistant engineer for the Grand Canal Improvement. From 1921 until his retirement in 1946 he was partner in Spooner and Merrill at Grand Rapids, Mich.

Marshall Barker Palmer (A.M. '07), age 85, retired civil engineer of Syracuse, N.Y., died there on July 13. After graduation from Cornell University in 1895, Mr. Palmer worked a number of years for the New York State Canals, and in 1908 started work for the City of Syracuse. From then until his retirement in 1940 he held various positions in the City Engineer's Office and the Bureau of Water.

Charles Andrew Pohl (M. '12), age 78, consulting engineer, died at his home in Suffern, N.Y., on July 8. Mr. Pohl graduated from Clarkson College in 1902 and in 1904 joined the New York State Barge Canal as assistant engineer. His long association with Colonel John Bogart, New York City consulting engineer, began in 1907 when he was his assistant. Mr. Pohl became partner in the firm of

(*Continued on page 104*)

Oscar Henry Koch, Former Director, Dies

Oscar Henry Koch, (M. '21), ASCE Director from 1945 to 1947, died at his home in Dallas, Tex., on August 7 at the age of 65. Mr. Koch, a partner in the Dallas consulting firm of Koch & Fowler which was formed in 1914, was a specialist in city planning and landscape architecture. During his forty-one years in consulting work he had served several Texas cities—Austin, Tyler, Abilene, Monahans, and Lubbock. From 1931 to 1935 he was director of public works for Dallas and from 1939 to 1941 was city planning site consultant for the United States Housing Authority for Region VI. He has been active in the Society and the Texas Section, which he served as vice-president in 1928 and president in 1931. Mr. Koch graduated from the University of Missouri in 1910.

Oscar H. Koch

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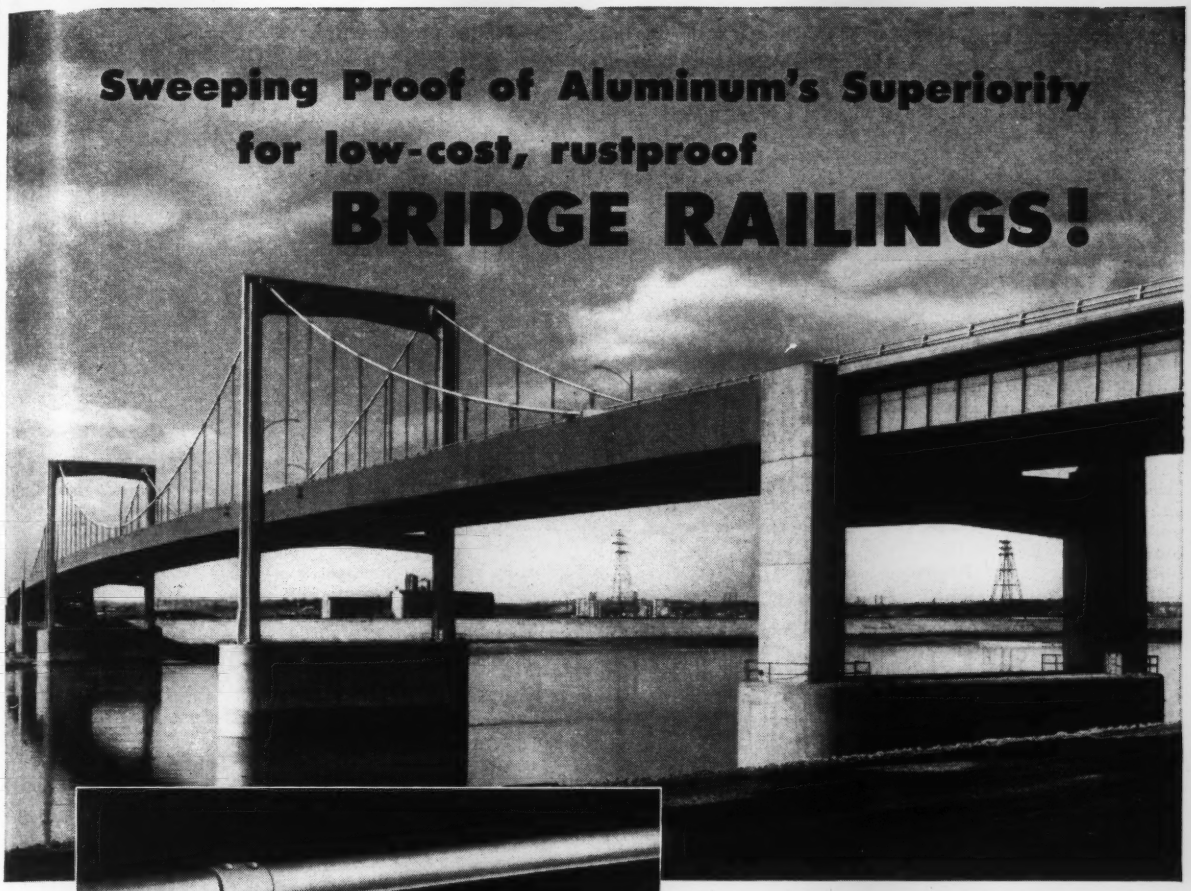

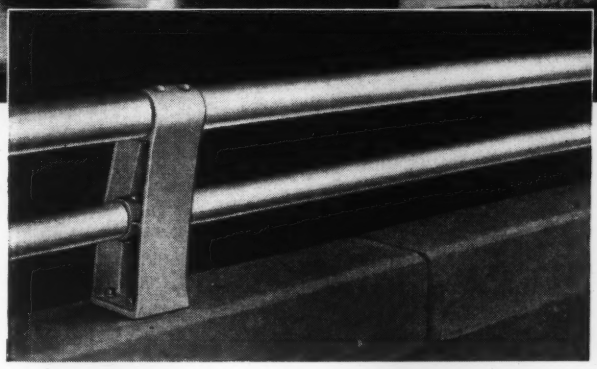

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REYNOLDS ALUMINUM

See "FRONTIER," Reynolds new dramatic series, starting Sunday, September 25, NBC-TV Network.

Deceased

(*Continued from page 102*)

Bogart & Pohl in 1912 and senior partner in 1920. A specialist in the field of hydro-power, water supply and rate cases, Mr. Pohl worked on the Hales Bar, Tenn., development for the Chattanooga & Tennessee River Power Company. He was a trustee of Clarkson College.

Henry Z. Pratt, Jr. (M. '48), deputy chief engineer of the New York City Board of Water Supply since 1952, died at his home in Pleasantville, N.Y., on August 10. He was 61. With the Board since 1922, Mr. Pratt had been in charge of the Research and Development Department and was one of the City's foremost experts on the development of water resources. He retired last June. Prior to joining the department, he had taught at the College of Hawaii and had worked for the Erie Railroad and the Vulcan Iron Works. Mr. Pratt graduated from Brooklyn Polytechnic Institute in 1915.

Paul Lyon Reed (M. '06), age 82, retired Captain, Civil Engineering Corps, U. S. Navy, died at Kensington, Md., on June 30. Captain Reed served in the CEC from 1902 until his retirement in 1936, and was recalled for duty during World War II. Civil engineer at various eastern stations for sixteen years, he was assistant chief of the Bureau of Yards and Docks in Washington from 1926 to 1930. He then served as public works officer at the Norfolk, Va., base. Captain Reed graduated from Rensselaer Polytechnic Institute in 1894. He was a resident of Washington, D.C.

Alexander Scott Reynolds (M. '52), age 52, with the Florida State Road Department since 1931, most recently as assistant state highway engineer, died in Charleston, S.C., on July 7. Following graduation from Virginia Military Institute in 1922, Mr. Reynolds worked for the Everglades Drainage District of Florida—as assistant engineer for six years. During the war Mr. Reynolds served as executive officer on both the Division Artillery Staff and the Division Staff of the U.S. Army, with the rank of major.

Rollin Ritter (A.M. '10), age 73, of Melbourne, Fla., died there on June 27. Prior to his retirement in 1952 Mr. Ritter had been a civilian engineer with the Third Army at Fort McPherson, Atlanta, Ga. For eighteen years he was in the U.S. Reclamation and the U.S. Indian Irrigation Service before serving as captain in the Artillery in France in World War I. From 1919 to 1925 he had a practice in Durango, Colo., and then was city engineer of Fort Lauderdale, Fla. Later he was with the Florida State Road Department. A graduate of Cornell University, Mr. Ritter received an M.E. degree there in 1903.

James S. Valach (J.M. '49), age 35, associate engineer for the City of Modesta, Calif., died on May 2. After graduation from Washington State College in 1949, Mr. Valach became assistant city engineer for the City of Pullman, Wash. Receiving an M.S. degree from the University of Illinois in 1952, he then worked as civil engineer for the Pacific Bridge Company in San Francisco, Calif.

William Mayo Venable (M. '07), age 84, since 1911 consulting engineer with the Blaw-Knox Company, Pittsburgh, Pa., died on June 3. Mr. Venable served as captain of Engineers in the Spanish American War (1898-99) and from then until 1911 was in charge of engineering on various projects—the East Boston Subway, the New Orleans Drainage system, and the Long Key Viaduct, Fla. His work for Blaw-Knox was in construction equipment. Mr. Venable graduated from the University of Cincinnati in 1892.

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Non-ASCE Meetings

American Hot Dip Galvanizers Association. Semi-Annual Meeting at the Sheraton-Belvedere Hotel, Baltimore, Md., September 29 and 30. Association address is 1806 First National Bank Building, Pittsburgh 22, Pa.

American Institute of Chemical Engineers. National Meeting at the Lake Placid Club, Essex County, N.Y., September 25–28. Further information from Office of the Secretary, AIChE, 25 West 45th St., New York 36, N.Y.

American Institute of Electrical Engineers. Fall General Meeting at the Morrison Hotel, Chicago, October 3–7. Further information from Raymond C. Mayer & Associates, 36 W. 46th St., New York 36, N.Y.

American Standards Association. Sixth National Conference (co-sponsored by the National Bureau of Standards) at the Sheraton Park Hotel, Washington, D.C., October 24–26.

Associated Equipment Distributors. Four-Region Meeting at the Chase Hotel, St. Louis, Mo., September 14–16. Further information from AED, 30 East Cedar St., Chicago 11, Ill.

Construction Surveyors Institute. West Coast Conference at the Ambassador Hotel, Los Angeles, November 14–16. Further information from G. Szmak, Executive Secretary, Construction Surveyors Institute, 101 Park Ave., New York 17, N.Y.

Engineers Joint Council. Nuclear Engineering and Science Congress and Atomic Exposition (sponsored by the American Institute of Chemical Engineers) in Cleveland, Ohio, December 12–16. Further information from EJC, 29 W. 39th St., New York 18, N.Y.

Institute of Traffic Engineers. Silver Anniversary Meeting at the William Penn Hotel, Pittsburgh, October 23–27. Further information from Chairman M. J. Gittens, City-County Building, Pittsburgh 19, Pa.

International Industrial and Technical Exhibition. Second International Exhibition at the Palais des Expositions, Charleroi, Belgium, September 17 to October 2. Information from Palais des Expositions, Rue du Manege, Charleroi, Belgium.

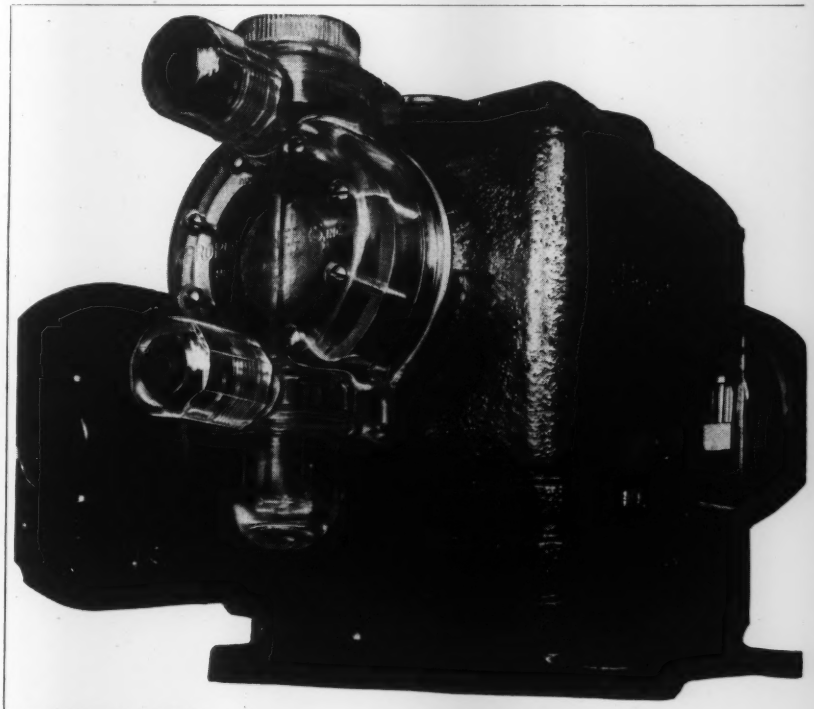
International Road Federation. Second International Meeting at the Food and Agricultural Organization Buildings, Rome, October 2–8. Further information from International Road Federation, 1023 Washington Building, Washington 5, D.C.

National Council of State Boards of Engineering Examiners. Thirty-fourth Annual Meeting at the Sheraton-Park Hotel, Washington, D.C., October 20–22. Further information from T. Keith Legaré, P.O. Drawer 1404, Columbia, S.C.

National Research Council. Fourth National Clay Minerals Conference at the Pennsylvania State University, University Park, October 10–13. Further information from A. F. Frederickson, Secretary, Clay Minerals Committee, National Research Council, Stanolind Oil & Gas Co., Stanolind Building, Tulsa, Okla.

National Society of Professional Engineers. Fall Meeting at the Peabody Hotel, Memphis, Tenn., October 14–15. Further information from NSPE, 1121 15th St. N.W., Washington 5, D.C.

Wire Reinforcement Institute. Annual Fall Meeting at The Inn, Ponte Vedra Beach, Fla., October 31–November 2. Further information from Frank B. Brown, Wire Reinforcement Institute Inc., National Press Building, Washington 4, D.C.



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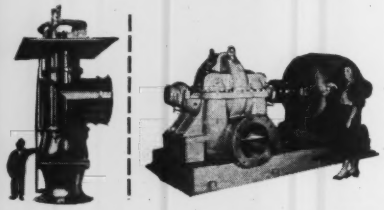

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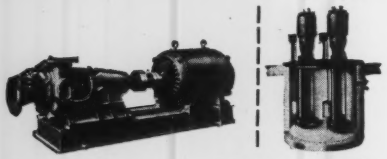

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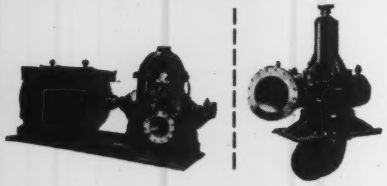

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Coordination, Control, and Financing of Industrial Research

This volume constitutes the Proceedings of the fifth annual conference on Industrial Research with some selected papers from the fourth conference. A wide range of topics is covered by authorities both from top management positions in industry and from university staffs. Abridged notes of the clinic sessions are included as well as the formal papers. Albert H. Rubenstein is the editor. (King's Crown Press, Columbia University, 2960 Broadway, New York 27, N. Y., 1955. 429 pp., $8.50.)

Irrigation and Hydraulic Design

Volume I: General Principles of Hydraulic Design

The present volume, the first of a projected three-volume study by Serge Leliavsky, is devoted to three main topics: percolation as a structural design factor, tail erosion, and the hydraulics of canals and rivers. Detailed consideration is given to such specific subjects as flow of water through a pervious soil, methods for flow net diagrams and seepage study, erosion of solid work (including cavitation), uniform and non-uniform flow, and others. A large number of charts, diagrams, and photographs illustrate the text. (Chapman & Hall Ltd., London—distributed in U. S. by Macmillan Company, 60 Fifth Avenue, New York 11, N.Y.—1955. 492 pp., $25.00.)

Modern Surveying for Civil Engineers

Intended for the surveyor in the field, this book by Harold Frank Birchal briefly covers in a practical manner items such as mathematics, chaining, leveling, angular measurements, tacheometry, stadia traverse, surveys for hydraulic works, tunnels, harbors, and aerial surveying; as well as information on the organization of field parties. Errors and misprints in the 1935 edition have been corrected. (Chapman and Hall Ltd., London, second edition, 1955. 528 pp., 50s.)

Precast Concrete

The first part of this work by Kurt Billig deals with fundamentals and general data, such as methods of design, production processes and treatment of precast concrete, its transport and erection, and the efficiency of prestressed concrete. The second and third parts discuss precast structural members and methods of joining them. The fourth is a survey of structures erected from precast members, or a combination of such members with concrete cast in place. (D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N.Y., 1955. 341 pp., $7.50.)

Proceedings of the Third International Symposium on the Chemistry of Cement

The twenty-two research or survey papers of the Cement and Concrete Association, London, contained in this volume are broadly classified as follows: constitution of Portland cement; setting and hardening of Portland cement; special cements; applications of research in manufacture and in utilization of cement. There is also an introductory article on the history of cement in England. There are detailed subject and name indexes. (Cement and Concrete Association, London, 1954. 870 pp., $9.00.)

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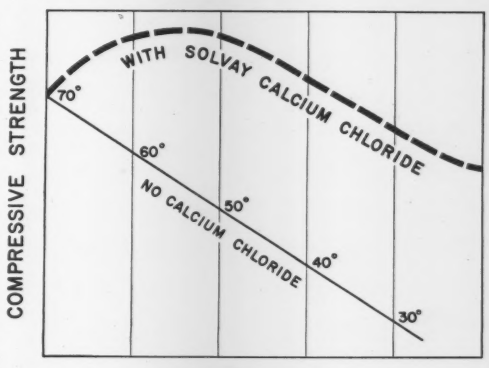

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Applications for Admission to ASCE, July 16, 1955–August 6, 1955

Applying for Member

Luiz Rodolpho Cavalcanti de Albuquerque Filho, Rio de Janeiro, Brazil.
Kwan You Chang, Honolulu, Hawaii.
Thevalil Subramanian Chathunny, Cochin State, India.
William Roscoe Clark, Little Rock, Ark.
Henry Augustus Denny, Pittsburgh, Pa.
Manuel Angel Gonzalez del Valley Hierro, Havana, Cuba.
Stephen Howard Haybrook, Potsdam, N. Y.
Edward Dickinson Hubbard, Richmond, Va.
John Robert Jannarone, Tulsa, Okla.
Leslie Frank Johnson, Atlanta, Ga.
Leslie Walter Pillar, Ottawa, Ont., Canada.
Remzi Libohova Remo, Istanbul, Turkey.
Remi Octavus Renier, Washington, D.C.
George Hubert Shipley, Gate City, Va.
John Alvin Shumate, Rolla, Mo.
Jack Ferguson Smith, Dallas, Tex.
Charles Theodore Tench, Mobile, Ala.

Applying for Associate Member

Arthur Malcolm Alpert, New York, N.Y.
Nicholas Paul Bellinghieri, Dedham, Mass.
Carlo Enrico Berghinz de Rosmini, Venice, Italy.
Bruce Campbell, Boston, Mass.
Paul Frederick Christiansen, Bethlehem, Pa.
Henry Hsien Chu, Chicago, Ill.
John Ignatious Coleman, Pittsburgh, Pa.
Fred Carl Cunningham, Los Angeles, Calif.
Hope Howe Dickson, Brownsville, Tex.
Emery Domingue, Lafayette, La.
Eamon Peter Fitzgerald, Kenya, East Africa.
John Browder Giddens, Jr., New Orleans, La.
Eugene Stirling Hill, Tacoma, Wash.
Henry Wyan Holliday, Anchorage, Alaska.
Alexander Homishak, Syracuse, N.Y.
Bernardo Jaramillo-Betancur, Colombia, S.A.
Clarence Walter Knecht, West Palm Beach, Fla.
Ralph Gilson Knowlton, Waterville, Me.
Robert George Lee, San Francisco, Calif.
Arthur Ingham McCutchan, New York, N.Y.
Mostafa Mozayeny, Denver, Colo.
Charles Arundel Murcott Moody, Jamaica, British West Indies.
Balcrisna Ramachondra Naique, Portuguese, India.
John Joseph Norton, Jr., Fort Worth, Tex.
James Joseph O'Dea, Jr., Paramus, N.J.
Guy Merriman Page, Dillsbury, Pa.
Pyara Singh Parmar, Nairobi, British East Africa.
Jack Sterling Petersen, Columbia, Mo.
Curtiss James Peterson, Omaha, Nebr.
Jacob Prag, New York, N.Y.
Robert Harrison Ramey, San Bernardino, Calif.
William Bruce Rick, San Diego, Calif.
Robert John Roberts, Moorhead, Minn.
Clifford Elwin Robinson, Los Angeles, Calif.
Reginald George Smith, Edinburgh, Scotland.
William Anthony Sontag, Las Vegas, Nev.
Samuel Jayasingh Thomas, Assam, India.
Daniel Elmer Westervelt, New York, N.Y.
John Hsun-Kuang Yuan, New York, N.Y.
Sermet Huseyin Yurtman, Nallihan-Barraji, Turkey.

Applying for Affiliate Member

James Francis Dear, Beaumont, Tex.

Applying for Junior Member

Turgut Yilmaz Balikcioglu, Nallihan-Baraji, Turkey.
Alberto Alejandrino Besa, Chapel Hill, N.C.
John Christopher Castanes, London, England.
Fred Theodore Glowacky, New York, N.Y.
Charlie Edward Hagwood, Fort Belvoir, Va.
Mehmet Bahri Kilic, Nalliham-Baraji, Turkey.
Edwin Doyle Lane, Baytown, Tex.
Juan Christian Luis Marcucci-Rivoal, Estado Julia, Venezuela.
Richard Woodbury Merrill, Augusta, Maine.
Alfonso Robels, Jr., Monterey Park, Calif.
Hans-Ruediger Schaeffer, Montreal, Que., Canada.

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

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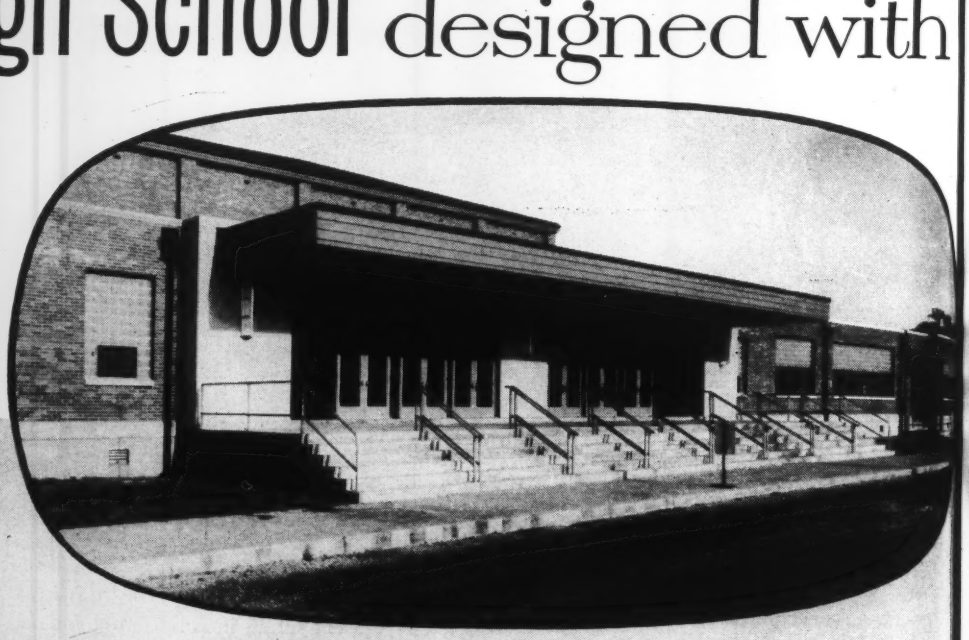
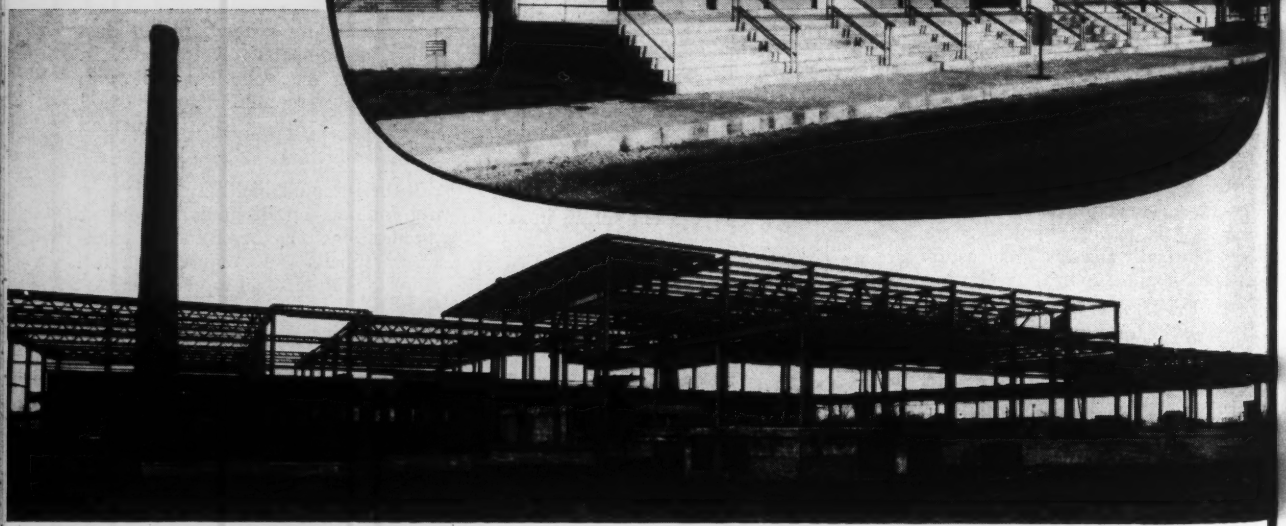
THE MAIN ENTRANCE of Assumption High School. The architects were Paul J. Saunders and Eugene S. Johnson. The engineer was John P. Nix. The general contractor was Wm H. and Nelson Cunliff Co.

TWO STORY ACADEMIC UNIT, connected to the one story unit to which a second floor may be added in the future.

New High School designed with

ENTRANCE to the gymnasium unit. The small doorway to the right leads into a classroom area.





THE STRUCTURAL FRAMEWORK during erection. The more than 348 tons of USS Structural Steel, used in the building, were fabricated by The Mississippi Valley Structural Steel Co., St. Louis, Mo.

future expansion in mind

The Assumption High School of East St. Louis, Illinois, was built to accommodate 650 students with provisions for expanding horizontally and vertically to provide facilities for an eventual one thousand students.

The school consists of three units: an academic unit containing classrooms; a gymnasium unit including gymnasium, cafeteria, shops, and laboratories; and a Brother's House, independent of the other buildings, which contains living quarters for 24 Brothers. The academic unit has provisions for expansion to the east. In addition, a second floor can be added to the present one story portion. The Gymnasium Unit is designed so that there is sufficient physical education, shop, laboratory, and cafeteria space for additional students if classroom facilities are increased.

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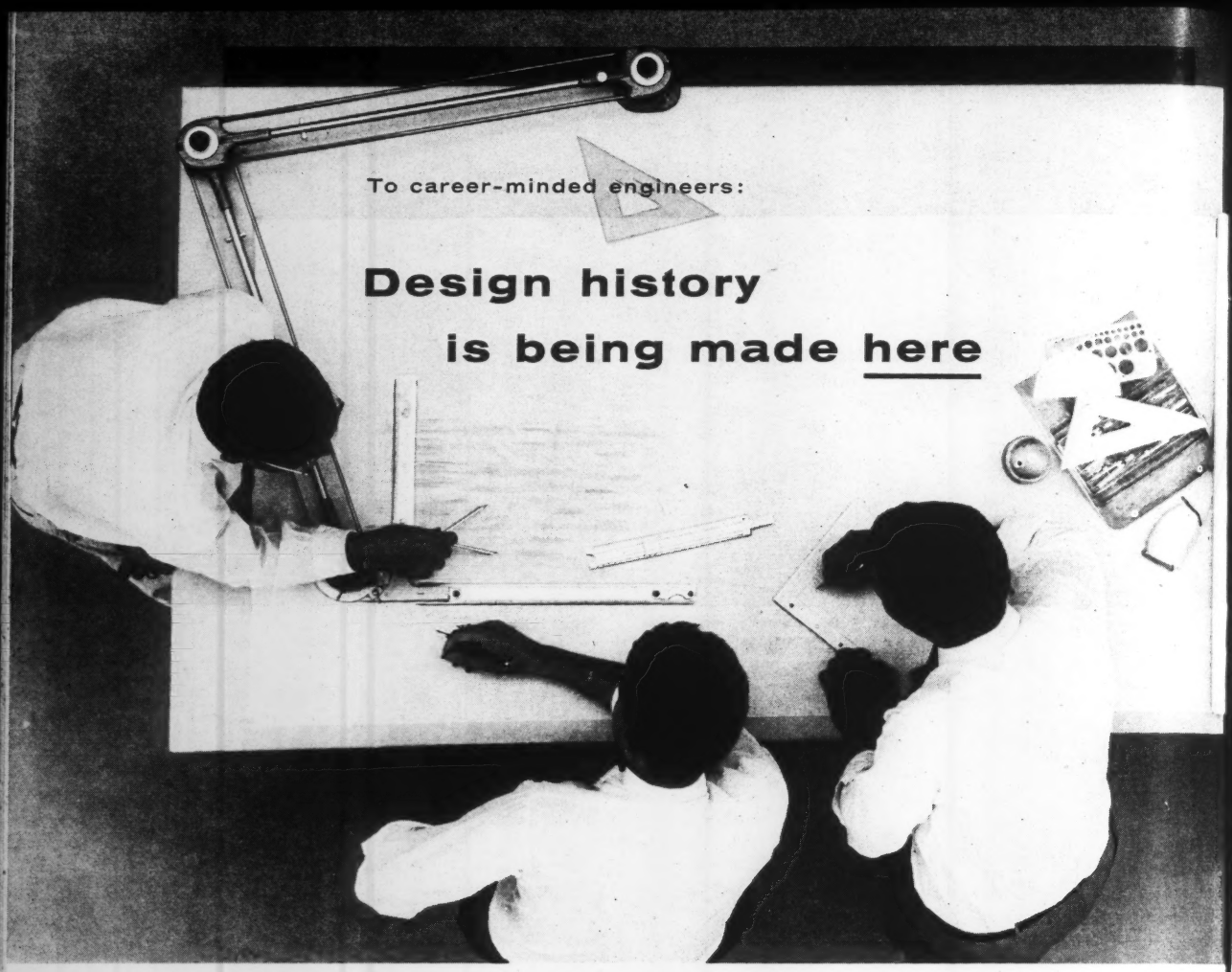

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(*Continued on page 114*)

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(*Continued from page 113*)

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ENGINEERS: (*a*) Construction Manager; 45–50; with experience in construction of petroleum and/or chemical plants, consisting of considerable process equipment—general building construction experience will not suffice. Salary, $10,000 a year plus bonus. Location, Delaware. (*b*) Chief Estimator; for national construction company dealing with the construction of petroleum and chemical plants. Salary, $12,000 a year, plus bonus. Location, probably Midwest. W-1845.

DESIGNERS, DETAILERS AND DRAFTSMEN; civil graduates; for office work on highways and expressways. Salary open. Location, Pennsylvania. W-1880.

ENGINEERS: (*a*) Construction Superintendent; experienced in erection of paper mills and getting up of paper mill machinery. Salary, $10,000–$12,000 a year. (*b*) Paper Mill Engineer; experienced in design specifications; purchasing for firm of consulting engineers on paper and pulp mill work. Salary, $12,000 a year. Location, New York, N. Y. W-1887.

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(*Continued on page 116*)

Annual Convention of ASCE
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Hotel Statler, Seventh Ave. & 32nd St., New York, N. Y.

Please reserve for my occupancy the following hotel accommodations:

Double.....Single.....

Double-Twin Beds.....Suite.....

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Date and hour of arrival.....

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AIRCRAFT ENGINEERS
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Recent Graduates with Aeronautical, Mechanical, Civil or Engineering Physics Degrees may qualify.

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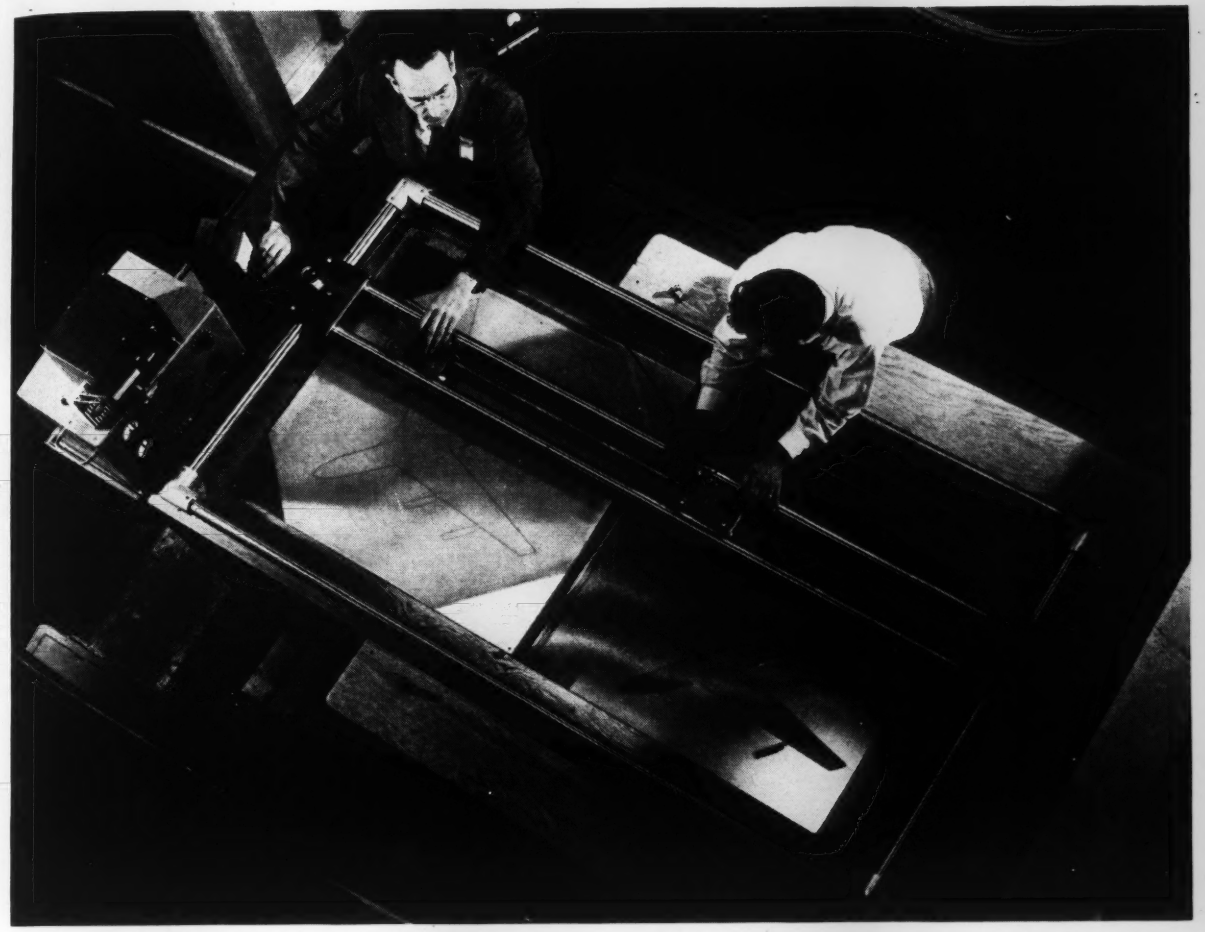

Boeing "C.E.'s" are kept free for creative assignments

Thanks to draftsmen and engineering aides, Boeing civil engineers are free to handle stimulating projects. Here, antenna properties are being determined with an electrolytic tank and three-dimensional plotter. Civil engineers play an important part in this research, and in applying it to the design of "years-ahead" Boeing aircraft.

At Boeing, civil engineers have the same relationship to draftsmen and engineering aides that doctors have to technicians and laboratory assistants. The skills of a Boeing civil engineer are fully utilized: in structural test, analysis and development, in developing new materials and new uses for them, and in designing structures to take the tremendous heat and strain of tomorrow's aviation.

This electrolytic tank is one example of the superb equipment at Boeing engineers' disposal. Other facilities include the world's most versatile privately owned wind tunnel, a new tunnel under construction, capable of velocities up to Mach 4, the latest electronic computers, and splendidly equipped laboratory and test equipment in the new multi-million-dollar Flight Test Center.

Achievements of each Boeing engineer are recognized by regular, individual merit reviews, and by promotions from within the organization. Boeing offers exceptional career stability and growth: this soundly expanding company now employs more than twice as many engineers as at the peak of World War II.

Do you want a chance to "spread your wings" in a truly creative job? There may be a place for you on one of Boeing's engineering teams in design, research or production.

JOHN C. SANDERS, Staff Engineer— Personnel
Boeing Airplane Co., Dept. D-43, Seattle 14, Wash.
Please send further information for my analysis.
I am interested in the advantages of a career with Boeing.

Name _____
University or
college(s) _____ Degree(s) _____ Year(s) ___
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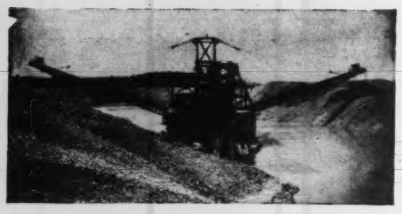
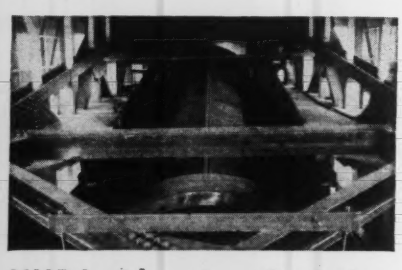
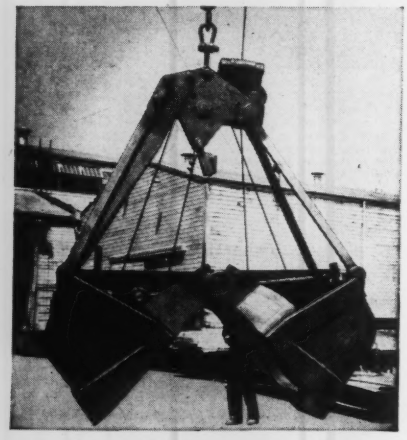


YUBA Bucket Ladder Dredges for dredging placer properties including rare earths, etc.; handling sand and gravel, dam construction, channel changes, etc., Bucket sizes: 2½ to 18 cu. ft. or larger. Digging depths below water as required.



YUBA Abrasion Resisting Steel Screens—Flat or revolving for separating, scrubbing, sizing. Holes taper drilled to prevent clogging. All thicknesses from ¼" up; other dimensions as needed. U·S·S· AR plate carried in stock.



Stockton "Yubabilt" Clamshell Buckets, for channel, harbor and reclamation dredging. Two types: California and Power Arm (shown here). Three weight classes: heavy, standard, special light weight. ½ to 6 cu. yds.

YUBA DREDGES — PROVED BY DEPENDABILITY ROUND THE WORLD

57

YUBA MANUFACTURING CO.

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Men and Jobs Available

(*Continued from page 114*)

MUNICIPAL ENGINEER; young; for public works department of small community. Work involves water works, sanitation, roads and highways. Location, eastern New York State. W-1946.

SANITARY ENGINEER; experienced in design and preparation of plans and specifications for water and sewerage plants. Permanent position, Location, southern Florida. W-1951.

GENERAL MANAGER; for large construction company; ten to fifteen years' experience in refinery and chemical plant design and construction. Salary open. Location, East. W-1958.

ENGINEERS; (*a*) Civil Engineers experienced in both the design, preparation of plans and supervision of construction of municipal water works consisting of distribution systems and water filtration plants, etc. (*b*) Sanitary Engineer to design and prepare plans for sanitary sewer systems and sewage treatment plants. Salaries open. Location, New York State. W-1963.

DESIGN ENGINEER; civil; four to six years' experience on reinforced concrete and structural steel design on industrial buildings; some experience on waterfront construction necessary. Salary, $6,000 a year. Location, New York, N. Y. W-1983.

CIVIL ENGINEER; with executive ability and estimating and field experience in pile driving; will manage foundation construction operations. Write stating qualifications and salary desired. Location, Pennsylvania. W-2005.

OFFICE AND FIELD ENGINEER; civil graduate; with field engineering experience, taking samples of underwater borings, quantity estimates and preparation of job drawings. Domestic and foreign trips. Salary, $6,500 a year. Headquarters, New York, N. Y. W-2009.

WANTED

LAND IMPROVEMENT ENGINEER

Must be **THOROUGHLY EXPERIENCED** with extremely rough terrain on very large home development project. Capable of supervising heavy earth moving equipment and making responsible decisions on grading, drainage, etc. Preferably man with surveyor's experience. Prominent position and excellent future with very large building organization. **ONLY** man with above experience considered. Write giving full details, availability and salary expected.

Box 255

CIVIL ENGINEERING

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New York 18, N. Y.

STRUCTURAL ENGINEERS

Engineering degree and responsible experience of at least three years in structural steel and reinforced concrete on bridges, buildings or heavy structures.

For established engineering consultants with international operations, located on gulf coast.

Send complete resume with name, address, and three references and salary requirements to:

Box 251

STRUCTURAL DESIGNERS & DETAILERS

Prefer CE or Arch E with several years' experience in bridges, industrial buildings, or pressure vessels and heavy ducting. Will consider lesser experience with good educational background in structural analysis.

Unusual engineering opportunities exist in our well established firm in connection with the design, construction supervision and inspection of a wide variety of engineering projects in both concrete and steel. Included are bridges, industrial buildings, advanced test facilities and other construction of an industrial nature, and various types of highway work.

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REINFORCED CONCRETE BUILDINGS...
COST COMPARISON PROVES THEIR ECONOMY

"900 Esplanade Apartments" and "Commonwealth Promenade Apartments" Chicago, Illinois

Ludwig Mies van der Rohe (Friedman, Alschuler & Sincere, Associated) Architect

Frank J. Kornacker Structural Engineer

Herbert S. Greenwald General Contractor

Sumner Sollitt Company Subcontractor

On the lake front of Chicago's near north side, the nation's tallest flat-slab reinforced concrete buildings are rapidly rising. They make up a $25,000,000 project of six 28 and 29-story apartment buildings—luxury "glass house" type—designed by the internationally renowned Ludwig Mies van der Rohe.

Mr. Frank J. Kornacker, structural engineer, said, "Reinforced concrete was chosen for economy reasons after a cost comparison with other structural methods. Another deciding factor was that materials were readily available."

Each year, an increasing number of buildings of all types are going to reinforced concrete construction. Reinforced concrete produces a rigid structure, highly resistant to wind, shock, and quake. Furthermore, materials and labor are readily available from local sources. On your next job, design for durability at low cost . . . design for reinforced concrete.

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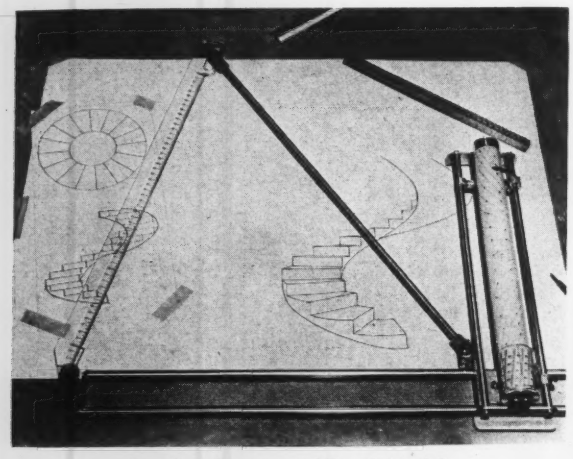
CONCRETE REINFORCING STEEL INSTITUTE

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

New Perspectograph



American Prototype of French Model

THE FIRST AMERICAN PROTOTYPE OF THE FRENCH PERSPECTOGRAPH, a technical drawing instrument which accurately transcribes plans and blueprints into perspective drawings in a fraction of the time formerly required can be fastened with thumb tacks to any drawing board, and is designed to operate on the principle of cylindrical panorama perspective. By means of a calibrated sweep arm and an abacus chart of curves, the user can translate an orthographic drawing into a perspective merely by plotting his perspective points and connecting them.

The Perspectograph produces worm's eye views as well as bird's eye views, and works backwards as well as forward, translating perspectives into orthographics. It has also been used experimentally to copy tracings made from photographs, and the result in each case has been a perfect orthographic drawing. Cost of the American Perspectograph is about $275. **Perspectograph Corporation, CE 9-118, 285 Madison Avenue, New York, New York.**

Mixed-Bed Demineralizer

DUE TO ITS EXTREMELY ECONOMICAL OPERATING COSTS, as compared with distilled water, demineralization through the medium of ion exchange is now coming into very extensive use in all phases of industry.

For the demineralization of relatively small quantities of water—up to 360 gallons per hour—a compact unit, the Model MBD-15 Demineralizer, has been developed. The device contains a resin bed consisting of an intimate mixture of cation exchanger, and strongly basic anion exchanger. It will produce a water of low total dissolve solids, low CO_2, low silica content and extremely low conductivity.

The device is 15 in. in diameter, 7 ft, 7 in. in overall height, and is protected with 6 coats of Heresite lining. **The Permutit Company, CE 9-118, 330 W. 42 Street, New York 36, N. Y.**

Horsepower Calculator Rules

TWO SIMPLE SLIDE RULES HAVE CUT THE TIME NEEDED to design a conveyor belt installation from three hours to ten minutes. The slide rules are a horsepower calculator and carcass, or belt fabric selector. Five settings on the horsepower calculator will give the horsepower needed for 98 per cent of conveyor belting systems. A maximum of seven settings will yield the drives for level, incline or decline, manually operated tripper and self-tripper systems.

This rule will select the correct belt fabric, once the horsepower for the system is known, in only two settings. Individual belt specifications are shown, and over 14,000,000 belt samples can be implied by the kit. **United States Rubber Company, CE 9-118, Rockefeller Center, New York 20, N. Y.**

Steel Spacer Strut

AN 87 FT LONG FABRICATED STEEL SPACER STRUT, as well as a special jacking frame, is being used to cantilever into place the nine upper strut sections of towers of the South Philadelphia-Gloucester Bridge over the Delaware River. The spacer strut, once placed in its temporary horizontal position, serves to counter deflection of the tower legs, each of which weighs 2,500 tons. When six to eight of the permanent strut sections are in place, their added weight would pull the legs a total of 4 in. toward each other, if the spacer strut were not there to hold them to the vertical. Weighing $7\frac{1}{2}$ tons, the spacer strut is a box member consisting of four angles laced together. It is 4 ft high and 6 ft 9 in. wide, back to back of angles. Positioned at the tower's center line, it is placed at the top of tier 9, just under the upper strut. The permanent strut frames to tier 10 at the top of the tower, which rises 370 ft above water level. **Bethlehem Steel Company, CE 9-118, Bethlehem, Pa.**

"Porta-Board"

AN ALL STEEL, ONE-PIECE COMBINATION MORTAR BOARD AND STAND for light and heavy construction, the Porta-Board folds to 4″ x 28″ x 30″ for easy storage and use coming out of an excavation or on a stepped scaffold. For ordinary use, the top stands 17 in. off the ground. In the folded position legs are locked and a handle is provided for easy movement around the job.

Among the board's advantages is the one piece steel top which allows smooth trowel movement, retains moisture, and cuts tempering of the "mud" by 50%. Rugged, welded construction is safe, durable, and will outlast many wooden boards. **Waco Equipment Division of the Crenshaw Supply Company, CE 9-118, 724 Boulevard, N. E., Atlanta, Georgia.**

Self-Propelled Shovel Crane

A NEW SELF-PROPELLED $\frac{3}{8}$ CU. YD., 6 TON SHOVEL-CRANE, MODEL CR-35, for materials handling and industrial applications, features 12,000 lbs lifting capacity, and an outside turning radius of $19\frac{1}{2}$ ft, which gives it extreme maneuverability for getting into tight working quarters to handle heavy loads. Another important feature of the crane is two-speed independent travel which allows the operator to work the upper deck machinery and

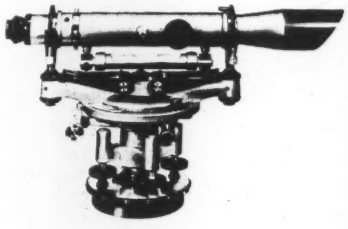
travel at the same time. The steering mechanism and brakes are controlled hydraulically, while the travel mechanism and upper machinery operate on fast-action, trouble-free mechanical control principle.

For maximum operator visibility the new rig features a newly designed all-vision cab, giving the operator 360 degree visibility for travelling, backing, etc. The full range of nine fast-change attachments are quickly interchangeable on the new self-propelled model, giving it the all-job versatility necessary for any one complete materials handling tool. They equip the new crane not only for materials handling work, but also for hundreds of cleanup, construction, and maintenance jobs common around industrial plants and materials handling operations everywhere.

The complete Model CR-35 self-propelled shovel-crane, including counterweight, outriggers, and standard 25 ft crane attachment carries a list price of $11,500 f.o.b. the factory at Waverly, Iowa. **Schield Bantam Company, CE 9-118–19, Park Street, Waverly, Iowa.**

Convertible Level

A 1955 MODEL CONVERTIBLE LEVEL GIVES EIGHT EXTRA ADVANTAGES AT NO INCREASE IN PRICE. A new cast brass internal focusing telescope is completely sealed against dust and dirt and employs 24 power coated optics with cross wires on a glass reticule. Time-saving features include a circular level mounted on the



1955 Model

top plate cover and a fast level position approximation. A nylon pinion bearing, a steel center and a level bar cast in one piece with the circle cover have been added. There is an eyepiece cap with a resetting scale that enables the user to reset to his individual need without using the telescope. **Warren-Knight Company, CE 9-119, 136 N. 12th St., Dept. E, Philadelphia 7, Pa.**

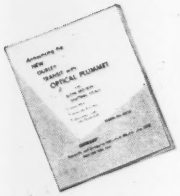
New Optical Plummet Built into Gurley Transit Saves Set-up Time, Improves Accuracy on Windy Days

Instrument Available in Two Models with Shifting Heads

Years ago, Gurley introduced lightweight instruments to combat wind vibrations. Now Gurley further beats the wind problem with an optical plummet *built into* the instrument.

The new Gurley Optical Plummet Transit eliminates swing and sway of the cord and plumb—always time-consuming and exasperating on a windy location, and inaccurate as well. Positive accuracy of set-up is assured with the Gurley Optical Plummet.

Two types of shifting head are available: one, which uses the Gurley wide-frame tripod, is adjusted over the point—using a method similar to the theodolite...the other, featuring a slow-motion, two-direction cross-feed head, permits movement in two directions at right angles to each other without disturbing the level of the plate.



Gurley's new Optical Plummet Transit offers one of the advantages of the optical-reading theodolite *plus* the desirable features of simplicity and universal acceptance of the American transit. For further details, write for Bulletin OP-57.

GURLEY

W. & L. E. GURLEY 518 Fulton St., Troy, New York

Gurley—Since 1845

SONOTUBE

FIBRE FORMS ®

for round columns of concrete

City Parking Garage, LaSalle St., Chicago, Ill. Plans prepared by Friedman, Alschuler and Sincere for the Bd. of Eng., City of Chicago. A. L. Jackson Co., builders.

Round columns save time and money!

. . . low cost ***SONOTUBES*** *make it possible*

Round concrete columns formed by low cost SONOTUBES helped save time and money in the construction of this parking garage.

SONOTUBE Fibre Forms are easy to handle because they are lightweight . . . quick to erect because they require minimum bracing . . . and economical to use because they are low in cost.

SONOTUBES are approved by architects and engineers and widely used by contractors everywhere. Available in 26 sizes, from 2" to 36" I. D. up to 50' long. Can be ordered in specified lengths or sawed to your requirements on the job.

Use Sonoco's patented "A-Coated" Sonotubes for finished columns; wax coated also available.

See our catalog in Sweet's

For complete technical data and prices, write

SONOCO PRODUCTS COMPANY
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AKRON, IND. — BRANTFORD, ONT.

MEXICO: Sonoco de México, S. A., Apartado 10239, México, D. F.

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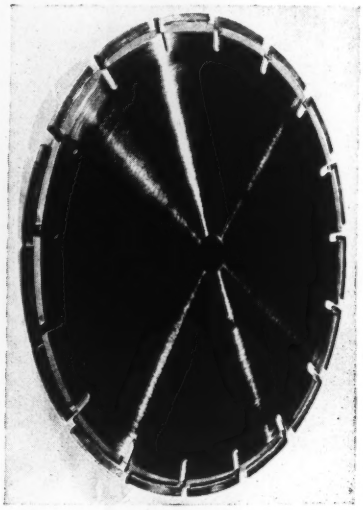
EQUIPMENT MATERIALS and METHODS

(continued)

Diamond Concrete-Cutting Blade

A NEW DIAMOND BLADE FOR SAWING JOINTS IN GREEN OR CURED CONCRETE has been developed. This new blade, bonded with tungsten carbide, and called the DM190, is superior to any other cutting blade now on the market. The comparison is judged on a cost per foot basis.

The new DM190 blade has proved its ability to cut at rates up to 10 f. p. m. at a depth of 2 in., depending on the type of aggregate used in the mix, the machine horsepower, and whether it is self-propelled or manually pushed.



Model DM190

Superior performance is due to an improvement in the design of the diamond segments mounted on the periphery of the steel center. Concrete cutting blades should be ordered by specifying diameter, thickness, and arbor size or type. **The Carborundum Company, Bonded Abrasives Division, CE 9-120, Niagara Falls, New York.**

Range Pole

A MODERN LIGHTWEIGHT RANGE POLE WHICH IS FORMED OF LIGHTWEIGHT METAL TUBING WITH A STEEL POINT AT ONE END provides excellent balance for plumbing. Eight-foot poles are made in two sections. Joining is by a slip-joint which provides the added feature that wear can be taken

EQUIPMENT MATERIALS and METHODS

(continued)

up by simply spreading the split-plug connector. No special tools are needed. A hand axe or jack-knife can be inserted in the slots to spread the metal, thus tightening the joint. The pole's top section has a plug which can be removed, so that an extra four-foot section can be added. **W. & L. E. Gurley, CE 9-120–21, Engineering Instrument Division, Troy, N. Y.**

Turbocharged Dozer

THE MICHIGAN MODEL 180 TURBO-DOZER, the first rubber-tired dozer powered by a turbocharged diesel engine, has a 165 horsepower rating and a capacity of two and three-fourths yds. It has a road speed of 27 m. p. h., the fastest in its field, and has four-wheel drive and rear-wheel steering which permits full power on wheels even while turning. Among operational advantages claimed by the manufacturer over existing equipment are hydraulic controls, a bowl which can be tilted by the operator while the machine is in motion and the ability to move under its own power over the highways. The Turbo-Dozer also features a power-shift transmission, a heavy-duty torque converter which automatically provides up to three to one torque multiplication and planetary wheel drive axles.

It is 8 ft., $4^3/_4$ in. high over the air cleaner cap, 9 ft, 9 in. wide at the bowl and 17 ft, 1 in. long with the bowl vertical on the ground. Its wheelbase is 7 ft, 4 in. and ground clearance is $14^1/_2$ in. Weight is 27,000 lbs.

Additional information on the new Michigan Model 180 Turbo-Dozer may be had by writing **Construction Machinery Division, Clark Equipment Company, CE 9-121, Benton Harbor, Mich.**

"Tape Rite" Applicator

WASTE ELIMINATION, FAST AND ACCURATE APPLICATION, AND SIMPLICITY OF OPERATION are three features of the Tape Rite applicator, a new one-hand dispenser for all pressure-sensitive tapes. It can be used wherever masking, sealing or joining tape is required in the construction industry. Tape pays out of the applicator, is firmly attached to the job surface by a resilient steel "finger," whose serrated edge cuts the tape in the desired spot.

Made of steel and finished in green metallic enamel; the 12 oz. unit will accommodate tape $^3/_4$" wide with a standard 3" core. List price per applicator is $2.39 f.o.b. Minneapolis, Minn. **Dep't. KP-1, GorDag Industries, Inc., CE 9-121, 815 E. 51st Street, Minneapolis 17, Minn.**

In a matter of hours CONNORS can have your re-bars at your job site anywhere in the South

Connors' flexible rolling mills, adjacent fabricating shops, mid-South location, and excellent truck and rail transportation—backed up by earnest efforts to provide good service—can help you "beat the clock" on your rebar requirements.

Fabricated to your exact specifications, Connors' re-bars are metal tagged for quick identification.

CONNORS PRODUCTS:
- Reinforcing Bars
- Merchant Bars
- Structural Shapes
- Hot Rolled Strip
- Studded T Fence Posts
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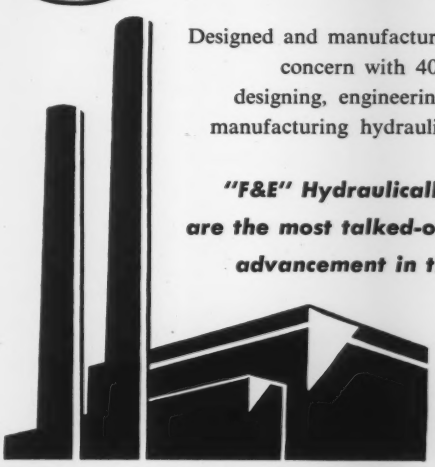
Progressive Cities select

F&E INCINERATOR STOKERS



Designed and manufactured by a century-old concern with 40 years' experience in designing, engineering and completely manufacturing hydraulically-powered stokers.

"F&E" Hydraulically-Powered Stokers are the most talked-of incinerator advancement in the field today.

Should you wish to see an "F&E" Incinerator Stoker in operation and get firsthand information on their revolutionary performance, we will be pleased to advise where the installation nearest you is located.

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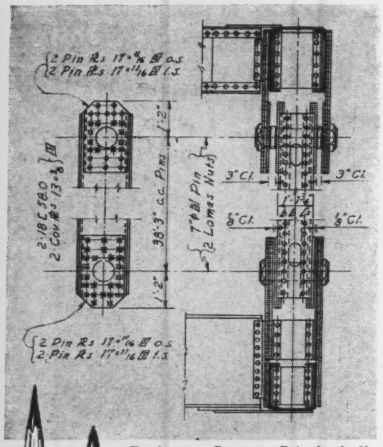
a vital detail



Engineers: Parsons, Brinckerhoff, Hall & Macdonald

This detail of a truss hanger joint for the Sunshine Skyway across Tampa Bay at St. Petersburg, Florida, permits the span to absorb deformations caused by temperature changes, variations in weight of traffic and other causes—a detail vital to the success of the project.

Another detail which top-flight engineers consider vital is the selection of proper tools—that's why so many use the Mars-Lumograph. They rate Mars-Lumograph imported drawing pencils and leads perfect for every step of the job, whether detailing or making working drawings.

Get imported Mars-Lumograph pencils or Mars-Technico push-button lead holder and drawing leads. You will be glad you did.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H—$1.50 per dozen—less in quantity. The 1001 Mars-Technico push-button lead holder—$1.50 each—less in quantity. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H—$1.20 per doz., less in quantity.

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at all good engineering and drawing material suppliers

EQUIPMENT MATERIALS and METHODS

(continued)

Portable Pyrometer

A PORTABLE GADGET THAT LOOKS LIKE A MICROPHONE ON THE END OF A LONG POLE has solved the problem of accurately measuring high temperatures of metals and refractories when surrounded by cooler air.

According to the company, the instrument will give accurate temperature readings within 0.5%, whereas contact thermocouples, formerly relied upon for measuring have an accuracy of about 5%. The Land Surface Pyrometer is suitable for measuring "spot" temperatures in a range from 100° F to 2400° F, and may be used for oxidized steel or cast iron, many oxidized non-ferrous metals, painted surfaces and others, regardless of their emissivity.

Temperature readings of high accuracy obtained with the instrument are made possible by its unusual design which produces near-perfect "black-body" radiation which is found in and between the framework of atoms that comprises the heated material, and also holds the key to its exact temperature. **Fielden Instrument Division, Robertshaw-Fulton Controls Company, CE 9-122, 2920 North Fourth Street, Philadelphia 33, Penna.**

Pocket Slide Rule

A NEW 5″ POCKET SLIDE RULE, SPECIALLY DESIGNED FOR "ON THE SPOT" CALCULATIONS, has machine divided precision graduations which are deeply engraved with black and red scales which will never wear off. Fabricated of pure white Divinyl plastic dimensionally stable, this pocket slide rule is resistant to acids, oils, etc. The complete 5″ rule scales are K, A, B, Cl, C, D, S, and T. The beveled leading edge incorporates both inches in 32nds and millimeter scales. Clearly and permanently engraved. Equivalent and Set ting Chart along with the Sine, Sine and Tangent and Tangentscales are on the back side of the rule with the hairline marker which insures perfect legibility. **Alvin & Company, CE 9-122, Windsor, Conn.**

Scout Model 70 Ditcher

THE ADAPTATION OF A DITCHER FOR INSTALLATION ON CRAWLER TRACTORS has been announced. Several new features have been added to the Scout Model 70 Ditcher for the crawler tractors, such as individually controlled, self-leveling hydraulic outriggers which keep the unit level regardless of the slope of the ground. The Ditcher digs 12 ft deep, loads $8\frac{1}{2}$ ft high, and reaches 14 ft. **Shawnee Manufacturing Company, Inc., CE 9-122, 1947 N. Topeka Blvd., Topeka, Kansas.**

Here are important facts for the "man behind the gun"

This White 18" Dumpy level has ...more of the features you want, yet costs you less!

Before you buy, compare this White Dumpy level with a similar model of any other recognized make. From every standpoint — design detail . . . quality construction . . . work-speeding, life-lengthening features and cost — you'll quickly see why a White's the best buy you can make. It will make your work faster, easier, more accurate. Check this comparison chart:

FEATURES	D. White No. 7080	Instrument A	Instrument B
Magnifying power of telescope	35X	30X	27X
Distance away you can read 1/100 ft. graduation	1200 ft.	1050 ft.	900 ft.
Diameter of objective lens	1.81 in.	1.485 in.	1.69 in.
Field of view (in minutes of arc)	64′	52′	60′
Coated optics	YES	YES	YES
Covered leveling screws	YES	YES	YES
Can you easily replace worn leveling screws in the field?	YES	NO	YES
Sensitivity of level vial (in seconds of arc per 2mm of graduation)	20″	20″	25″
Price — complete with carrying case, tripod and accessories — F.O.B. factory	$295.00*	higher	higher

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NEW ALL-WELDED BRIDGE SAVES 20% ON STEEL

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AN estimated 20% less steel is needed on this skyway than would have been required for riveted construction. This saving not only has cut cost of structural steel but has made further reductions in cost of foundations since the underfooting in the area is extremely poor.

The design is such that welding is largely done in the shop by low-cost automatic Lincolnweld or semi-automatic Manual Lincolnweld submerged arc process.

The bridge is a composite design in which the concrete slab of the deck is supported by girders. The girders have shear connections welded to the upper flange of the beams. As a result, the slab acts as an integral unit with the supporting beams and girders.

Fabricators are the Independent Iron Works and Judson Pacific-Murphy Corporation of Oakland, California.

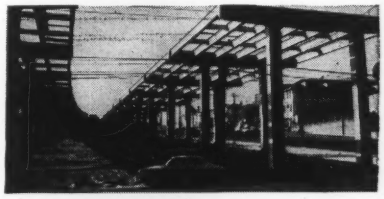

Fig. 1. Divided highway two-column bent for a street overpass.

Fig. 2. Welding diaphragm to connecting plate at column bent.

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EQUIPMENT MATERIALS and METHODS

(continued)

Trenchliner

HERE IS A TRENCHER THAT CAN GO WHERE OTHER ONES CAN'T! Because its engineers stressed minimum dimensions and clearances, this machine can work in congested areas usually inaccessible to a trencher of similar capacity. Compact design, low center of gravity and low ground bearing pressure make the ladder-type Model 155 Trenchliner capable of a variety of digging. The trenchliner produces from 5.8 in. to 12.75 lineal ft of trench per minute in a range of 30 speed selections by lever control. A higher range of 30 speeds, up to 25 lineal ft per minute, is made available by a simple sprocket change. With a maximum depth capacity of 8 ft and widths from 16 through 26 in., the Model 155 is well-suited for a wide work range including sewer, water, gas mains and services, as well as general utility and construction jobs. Other features of Model 155 include: hydraulically actuated boom hoist that incorporates a positive down crowd; a power shiftable and reversible belt conveyor that discharges spoil to either side and at selective distances from the trench wall; friction type clutch for bucket line drive that serves as an automatic safety to protect machinery from shock loads; choice of 16, 20 or 24 in. buckets to which oversize adaptors can be fitted to increase trench widths by 2 or 4 in. **The Parsons Company, CE 9-123, Newton, Iowa.**

Steel Shoring

THREE ACCURATE CONCRETE SHORING METHODS, USING QUICKLY-ASSEMBLED STEEL SCAFFOLDING, are now helping contractors gain important savings in building time and costs, and maximum safety. The rapid growth in the use of steel shoring methods is due largely to its advantages over wood shoring built on the job. In general, there are three types of steel shoring that are enabling contractors to meet the specific requirements of all types of modern concrete construction: Sectional Steel Shoring can be wheeled to new locations on the same floor, or lifted vertically to the next floor. Sectional Steel Shoring is adaptable to all types of concrete construction: Flat slab, slab with drop heads, pan joint with 20 in. or 30 in. pans, intermediate beam, and poured arch. Single-Post Steel Shores can be easily carried, erected and accurately leveled by one man. Tube-and-Coupler Steel Shoring conforms easily to unusual job conditions such as extreme heights, irregular contours and uneven ground. **The Patent Scaffolding Co., Inc., CE 9-123, 38th Ave. & 12th St., Long Island City 1, N. Y.**

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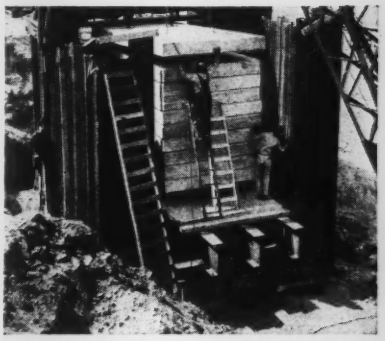

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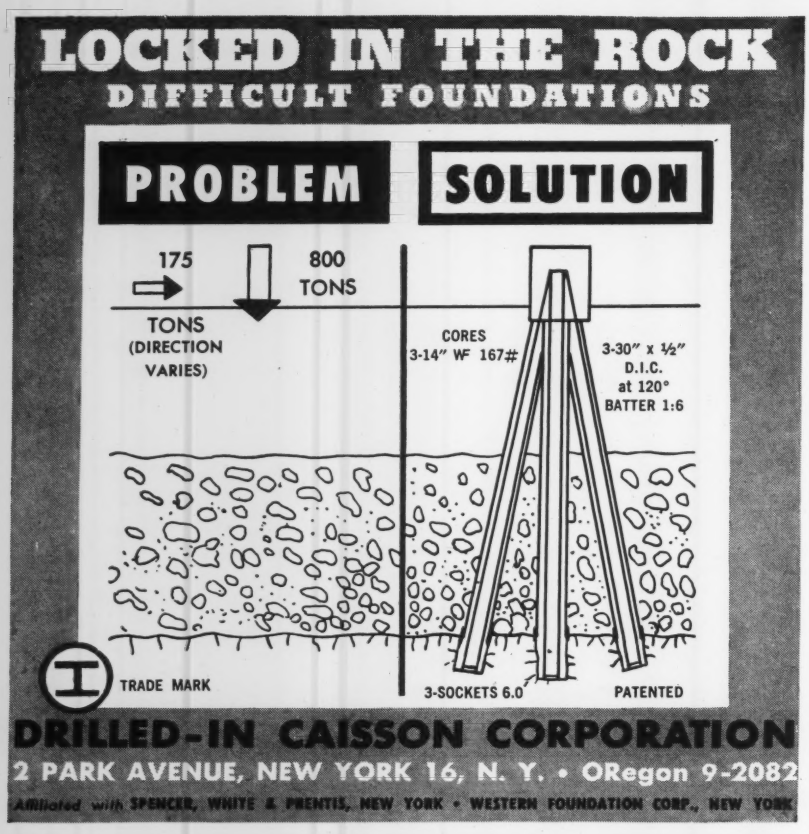

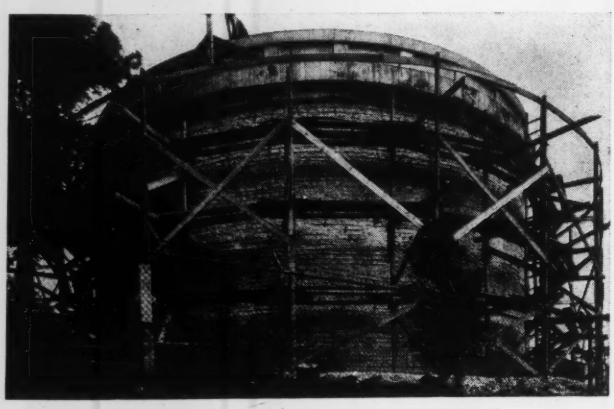

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The progress picture above shows a stage of our repair work on a concrete water tank in New England. This tank was completely lined with reinforced "GUNITE" to stop seepage which had caused serious disintegration to the exterior of the tank. The entire outside of the tank was subsequently chipped and existing hoop rods exposed.

To strengthen the tank, wedges were driven behind the rods to take up the slack. This placed the rods in tension and the concrete in direct compression. Wire mesh was then attached to the reinforcing rods and the entire tank treated with two inch mesh reinforced "GUNITE."

The use of "GUNITE" for repair and construction of reservoirs, bridges, buildings, etc., is illustrated and described in Bulletin B-3000. We will gladly send a copy at your request. On your letterhead please.

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EQUIPMENT MATERIALS and METHODS

(continued)

Electric Screed Package

THE FIRST ELECTRIC SCREED PACKAGE ASSEMBLY has just been put on the market. When mounted on a beam, this screed can be pulled along by two men, striking off the concrete smoothly and, at the same time, vibrating the concrete. This screed is used extensively on concrete bridge decks, airport aprons, floors and roadways. The electric screed consists of a one hp enclosed electric motor with a thermo overload switch and a cord with complete twist lock plug; vibrating unit that delivers 5100 vibrations per minute; brackets for mounting the motor to the beam; a pair of end rollers, handles and all the necessary bolts. On many jobs, this screed package can be bolted to any beam. However, for some slabs, where the surface must be flat, a prestressed beam can either be ordered or built. **Stow Manufacturing Co., CE 9-124, 93 Shear St., Binghamton, N.Y.**

Wind-Free Plummets

TWO WIND-FREE PLUMMENTS, ONE AN OPTICAL TYPE, THE OTHER A TELESCOPIC ROD TYPE, have been made to fit both European and American tripods. Both instruments are unaffected by high winds, are self-leveling and lightweight. The optical plummet is designed around a double-image sighting system. The observer looks through a window at the side to see two images of the stake tack. These two images move into coincidence when the instrument is directly over the tack. The telescoping rod, made of high strength aluminum alloy tubing, is fitted with an eight minute level vial, giving an accuracy of $^1/_{64}$ in. in its entire length. This can be reduced to 0 by turning the plumb rod through 180° and centering the bubble reading. **David White Company, CE 9-124, 315 W. Court St., Milwaukee 12, Wisconsin.**

Filter Bottom

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DRILLING MACHINES—Illustrated leaflets describe two new diamond core drilling machines (Models 30 and L-2) to meet the demand for compact units which can be moved easily from one location to another and can also be relied upon to produce good cores rapidly, up to moderate depths. **Sprague & Henwood, Inc., CE 9-125, Box 446, Scranton 2, Penna.**

GAS STORAGE—Available for distribution are reprints of the six-page article entitled, *Greater Gas Storage in Hortonspheres*, which discusses the advantages of using high strength materials in the fabrication of spherical pressure vessels. The impact and hydrostatic pressure tests for USS T-1 are described. Included are volume, diameter, pressure relationship charts comparing the commonly used premium steels. **Chicago Bridge & Iron Company, CE 9-125, 332 South Michigan Avenue, Chicago 4, Illinois.**

SEWAGE TREATMENT—A new general bulletin containing photographs, drawings, and descriptions of water, waste, and sewage treatment equipment has been released. The 24-page catalog is attractively printed in two colors and serves as an excellent introduction to this firm's coverage of municipal and industrial treatment processes. **Walker Process Equipment Inc., CE 9-125, P. O. Box 266, Aurora, Illinois.**

AUTOMATIC WELDING—A new 16-page catalog featuring welding equipment has just been made available. Manual and automatic units along with accessory apparatus and welding wire are included in the illustrated booklet. **Air Reduction Sales Co., CE 9-125, 60 East 42nd Street, New York 17, New York.**

"WEIGHT-RATE-PROFIT"—Truck operators now can actually compute the profit available through the use of aluminum trailers, bodies and wheels by consulting the new "weight-rate-profit" chart, formulated from the actual operating records of leading aluminum truck operators and owners. By using such known factors as the weight saved with aluminum trucks or trailers, plus the average rate for cargo carried and the number of trips per year, chart users can compute their yearly extra profits. **Aluminum Company of America, CE 9-125, 767 Alcoa Building, Pittsburgh 19, Penna.**

ZINC CONTROLS CORROSION—*How Zinc Controls Corrosion*, a new 32-page illustrated booklet describes the many ways zinc lengthens the life of steel products, and reduces maintenance costs. Drawings, charts, and photographs together with brief comments present the corrosion control characteristics of zinc coatings, zinc pigments, and zinc anodes. An extensive selection of farm, industrial, marine and building applications of zinc is reviewed. **American Zinc Institute, CE 9-125, East 42 Street, New York 17, N. Y.**

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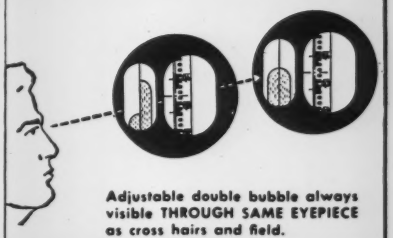

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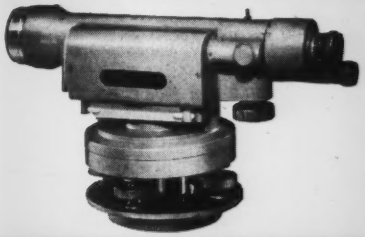

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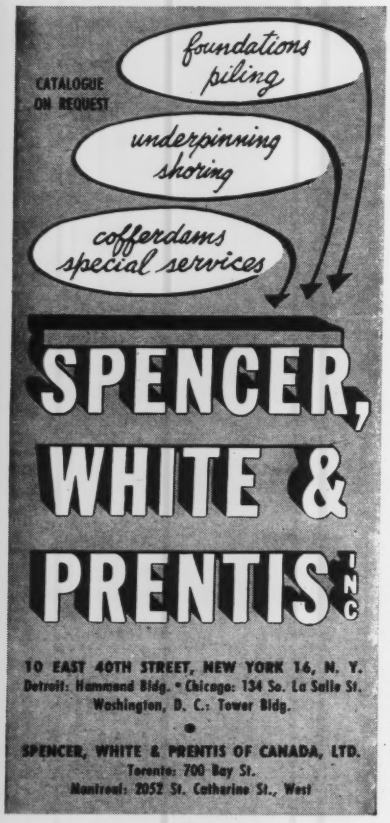
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From the MANUFACTURERS

WORLD'S FAIR OF POWER: The General Motors Powerama will be held August 31 to September 25 in Chicago. Its purpose is to portray the dramatic contributions of Diesel and aircraft power to America's industrial economy, and to celebrate the productions this year of GM's 100 Millionth Diesel Horsepower . . . . **COPPER QUEST**. Eastern Nevada is the site of a huge expansion in the never-ending search for copper. The Isbell Construction Co. of Reno has undertaken the strip mining operation for Kennecott Copper Corp. and Consolidated Coppermines Corp., both of which have other extensive mining operations in the area . . . . **BANKING IN THE SKY**: The State Bank & Trust Co. of suburban St. Louis (Wellston, Mo.) has in its new building a system whereby its customers simply drive through a gate, over an asphalt-topped lot onto the concrete bank roof where they can use one of the two 'Snorkel' tellers without leaving their cars, or park their cars and enter the bank by means of an elevator or staircase . . . . **ACQUIRES GOLD**. Certain-teed Products Corp. has announced that it has agreements with the holders of 98% of the stock of Gold Seal Asphalt Roofing Co. to purchase their stock for cash . . . . **TEX GETS HOME**. Royal Little, Chairman of the Board of Textron American, Inc., announced the purchase of the Homelite Corp. of Port Chester, New York . . . . **ELECTIONS**: Lehigh Portland Cement announces the election of Mr. C. Glenn Browning to the position of Executive Vice President of Sales, and Mr. P. A. Groll to that of Executive Vice President of Manufacturing . . . . Robert W. Lefferts succeeds George Kilian as secretary-treasurer of Penn-Dixie Cement Corp . . . . C. L. Meanor has been elected President of the Clay Flue Lining Institute, an association of 11 manufacturers located in Ohio, Pennsylvania, Indiana, and Michigan . . . . Election of L. S. Stanley as a Vice President was announced by the board of directors of Booth & Flinn Co. . . . **APPOINTMENTS**. Mel E. Maurer, a former production executive with Lockheed Aircraft and Hotpoint, is now President of the Flex-O-Tube Division of Meridan Corp. in Inkster, Michigan . . . . C. F. Mittelstadt became Chief Engineer of the Heltzel Steel Form & Iron Co. and its wholly owned subsidary, The Flexible Road Joint Machine Co., both of Warren, Ohio . . . . Donald J. Beach will cover Michigan, Indiana, and Western Kentucky for Flexible Steel Lacing Co. . . . William L. Sheets, of Los Angeles, has been appointed a construction manager of Stone & Webster Engineering Corp. . . . Yale & Towne Manufacturing Co. has announced the establishment of two additional representatives in Indiana and Illinois, headed by Jere Kimball and Harry W. Carpenter, respectively. . . .

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761. **Survey of Salaries for Civil Engineering Positions, by the Committee on Salaries of the Department of Conditions of Practice.** (BD) The latest in the series of salary surveys has been made for three preprofessional and nine professional grades including a geographical comparison and a listing of annual earnings of several classifications. In comparing this with the 1953 report, it is noted that salaries continue to increase in all professional grades and that proportionately greater increases in compensation have resulted for those in higher positions.

762. **Investigation of Floorbeam Hangers in Railroad Trusses, by C. H. Sandberg.** (ST) The paper reviews research and tests made to determine the causes and possible remedies for failures in floorbeam hangers. The program consisted of a fact-finding survey, strain measurements on actual bridges, theoretical analysis, and laboratory investigations.

763. **Sequence Summation Factors, by Adrian Pauw.** (ST) This paper defines a new structural parameter, the "sequence-summation factor," which may be used in the systematic computation of "over-relaxation" factors for moment-distribution processes. A procedure for computing the total joint relaxation moments is also introduced.

764. **Plastic Strength of Steel Frames, by Lynn S. Beedle.** (ST) Results of large-scale experiments are considered in the light of theoretical predictions and are correlated with current design specifications. The fundamentals of plastic analysis are briefly described. It is shown how the design of ordinary structural frames may be based on the maximum load the structure will support.

765. **Discussion of Proceedings Papers** 132, 313, 449, 468, 540, 583, 586, 588. (ST)

766. **Environmental Considerations in the Development of the Atomic Energy Industry, by Arthur E. Gorman.** (CP) Much care must be exercised in releasing radioactive wastes from commercial plants to be located near centers of population. This will call for careful advance planning of sites, the location of plants on-site with relation to one another and their facilities, and the evaluation of environmental factors.

767. **Prospects for Use of Nuclear Power, by H. W. Huntley.** (CP) In this paper the functions of the various types of materials found in nuclear reactors are presented. Five reactor types are described and related to types of materials; the costs of the reactors are compared with those of modern steam stations. Some generalizations are made concerning the integration of nuclear power plants into the power industry.

768. **Elementary Principles of Nuclear Power, by John W. Landis.** (CP) The principles of nuclear reactor theory and construction and the general types of reactors are described. Certain problems encountered in design and operation and their possible solutions are indicated.

769. **Some Observations on the Urban Transportation Problem, by Harmer E. Davis.** (CP) In this paper the interrelationship of urban development and transportation is sketched. A series of observations pertaining to the urban transportation problem, as it now must be considered, is then presented.

770. **Water Supply and Sewerage System Planning for Greater Karachi, by Carroll V. Hill and Vance C. Lischer.** (CP) A review of a master plan for providing a new supply of water from the Indus River and the study and development of a master plan for sewage collection and disposal are described. The paper also includes the economic and political background of Pakistan as well as some differences between its engineering practices and those of the United States.

771. **Grillage Beams on Elastic Foundation, by Bernard Drapkin.** (EM) The geometric and elastic quantities influencing the maximum moment under a concentrated load for a beam on an elastic, homogeneous, isotropic halfspace are represented by parametric curves. A simple formula is presented for steel beams on rock or concrete loaded by a single concentration at the center.

772. **Dead-Load and Live-Load Moments in Shells of Revolution Built-In into Cylinders, by John V. Huddleston and Mario G. Salvadori.** (EM) A method for determining the moments in thin shells of revolution connected to vertical cylinders that occur near the point of juncture due to the weight of the shell is presented. The results are plotted on graphs enabling evaluation of edge moments and shears and the maximum moment in shell or cylinder.

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